<u>Faculty Participants</u>

Abul Azad
Brian Coller
Abhijit Gupta
Reinaldo Moraga
Ibrahim Abdel-Motaleb
Regina Rahn
Robert Tatara

I Love Teaching at NIU

Volume I-Section A: Initiative, Models and Program

Volume II: Research and Evaluation Data Reports

Volume III: Program Worksheets; Forms; and Instruments

Volume IV-Section D: Presentations

NORTHERN ILLINOIS UNIVERSITY

The Scholarship of Teaching
The CEET Initiative on Teaching and Learning

Jule Dee Scarborough, Initiative Director

College of Engineering and Engineering Technology

Promod Vohra, Dean

Program Associate: Jerry Gilmer, Director, NIU Testing Services
Editor: Gail Jacky, Director, NIU Writing Center

October 2005-December 2006

The Scholarship of Teaching:
A Response to the National Call for Action

The CEET Pilot Initiative on Teaching and Learning

A "Living" College Portfolio
For Learning, Taking Action, and Reporting Results and Outcomes
First Edition: Volume I, Section A - Initiative

College of Engineering and Engineering Technology
Northern Illinois University

Jule Dee Scarborough, Ph.D., Distinguished Professor
Program Director

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May 2007

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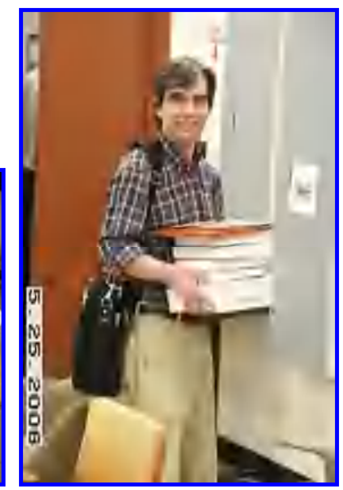
Dean

The Scholarship of Teaching
CEET Initiative on Teaching and Learning
PORTFOLIO
College of Engineering and Engineering Technology



Robert Tatara **Reinaldo Moraga**

Engineering Building

Electrical Engineering
Industrial and Systems Engineering
Mechanical Engineering

College of Engineering and Engineering Technology

Technology Buildings

Electrical Engineering Technology
Industrial Technology
Manufacturing Engineering Technology

FOREWORD

This CEET Initiative is our first attempt to prepare professors for the Scholarship of Teaching. As engineering and technology professors, they had little background on teaching and learning or on educational research. With the ultimate goals of improving teaching, increasing student learning, and performing research on teaching and learning, it was important to construct a foundation upon which to build knowledge, understanding, and meaning. When we say "to increase student learning," we mean that we desire to deepen learners' understanding and to engage them in creating meanings that are purposeful and relevant while in our courses and learning experiences. As we begin, we are fully cognizant that our vision and mission will take some time to achieve and that data needed to provide evidence we are accomplishing our goals will take time to collect across many courses and students. However, we have begun. This initiative has engaged us in critical reflection, analysis, and development, culminating in formal classroom research. The process of our reflective practice and the results are reported fully in this college portfolio.

Themes of thought are transparent across the sections of our portfolio and across many different constituencies regarding teaching, student learning, and the Scholarship of Teaching. The authors, ideals, thoughts, perspectives, research, studies, and philosophical meanderings all arrive at similar places. The voices of our authors seem to be in harmony and agree that students learn differently, that they learn more if they are engaged in purposeful and meaningful activity while learning, and that students can achieve learning at the upper levels of cognitive processing if knowledge is learned in authentic contexts ("in situ" – requiring real-world performances, structured as inquiry, less didactic, and discovery oriented) and designed to result in open-ended solutions that may differ across students or cooperative learning groups. Additionally, learning is social (not isolated), and students must discover and learn to hear their own inner "voices," such that they openly question and seek to transform knowledge and make meaning, thus transforming and recreating themselves and their world and re-perceiving their relationship to the world. Our ultimate reward would be that they become part of the generative process of life with the capacity to create their own future, applying a definition of technology that resonates with me: "the science of efficient action that extends human capacity and potential." Real learning is analogous in that it extends human capacity and potential and makes it possible also to extend the capacity and potential of cultures.

Educational research is social science, which is sometimes "messy" and often very unlike engineering research because of the social aspect. The quality of empirical research on teaching and learning varies, as do its outcomes, and there are a great number of more qualitative or anecdotal studies that are not always as reliable but are often worthy of consideration. However, as we searched to confirm our direction, we found that thoughts and perspectives of a variety of current and well-known researchers, thinkers, theorists, and practitioners, as well as those who established the historical foundations of teaching and learning, were generally in synchrony. Therefore, we felt there were themes of agreement transcending across the myriad of fields or schools of thought relating to teaching and learning. It is those consistent themes that we used to confirm our direction and, where necessary, to further inform our direction. Included, and possibly important to note, are those who study the lives of college students. Thus, we have chosen to describe the demographics of our students using qualitative information alongside the standard statistical information. It is interesting that although the perspective comes from studying the student (as a "person") and "their lives," those studies make a significant contribution toward understanding how students learn best and demonstrate

or provide evidence of their learning. Students' feelings, attitudes, experiences (and lives in general) go far to provide insight and implications for working with them in the classroom. This information supports the teaching and learning themes, confirming the best theories, practices, and strategies to achieve the greatest learning potential of our students: from the GIs and Boomers forward to Gen Xers and the Millennials.

This is the beginning of our quest not only to engage in the continuous improvement, or quality cycle, of teaching and learning, but to go beyond to begin to formally study teaching and learning – the Scholarship of Teaching. This is the first edition of our college portfolio. To some, it may be far too simple. Others, at our stage, may feel overwhelmed by what we have tried to accomplish in the first "round" of the initiative. Many will respect how we have tried to draw from an overwhelming and complex amount of research and information on teaching and learning, scholarship, students, learning communities, and more. Others may feel that we have begun too broadly and would be more critical of lack of depth. Some may feel that the foundation we have created is somewhat superficial; yet others may feel it is good enough and use it as their foundation.

Regardless, we have tried to create an informed foundation from which to evolve. Our foundation, program, research, results, and products are presented here for review. We realize that in revealing all aspects of our work, the door for criticism is open much wider than reporting from a more limited and focused perspective. However, since we have adopted the models, strategies, processes, and techniques that we hope to use in our classrooms, if honest and committed to developing and hearing our own inner voices and realizing when they limit us, then we honor those other voices that may confirm our direction and goals. We equally welcome those voices who would challenge us to critically reflect upon our directions, thoughts, and decisions, as those voices stimulate transformation by helping us to either admit the current reality and/or engage in discovery though intentional action. Thus, we hope we are no longer in a reactive mode, but instead that we have begun to create a new teaching, learning, and research environment. In doing so, we hope to strengthen the authentic power generated from within, where critical reflection, thought, change, and the community engagement of different voices make us all more than we were before, and that, individually and collectively, we recreate ourselves.

We encourage you to use our work, reflect upon it critically, identify its strengths and weaknesses, and ultimately engage with us in the transformation of our teaching and learning environment and new research adventure – the Scholarship of Teaching.

Jule Dee Scarborough, Ph.D.
Distinguished Professor

Promod Vohra, Ed.D. PE, Dean
College of Engineering & Engineering Technology

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Recommended Bibliographic Listings

Various sections of this Portfolio should be referenced or sourced differently. We were advised to suggest the following:

Portfolio: Scarborough, Jule Dee, Initiative Leader (primary author of the document and data reports)
Individual Sections in the Portfolio, author of that section as included in the Portfolio.

Note: The presentations on Active Learning are developed directly from the book: Johnson, D.W., Johnson, and R..T. and Smith, K.A. (1998) ***Active Learning: Cooperation in the College Classroom..*** Several of us in this initiative attended their workshop.

Section B. This section includes all data and reports. Source each according to authorship. However, each faculty member artifact or example is named. Therefore, if sourcing an example within the section, source the faculty member as well as the section author. Source them individually for any artifact or program product example used alone. Finally, a DRAFT manuscript about the experimental classroom research or the implementation of new teaching and learning strategies, models, and procedures is also included by each faculty member participant. Two of these manuscripts have been accepted for publication; several others are in process, and the others are going to be submitted to appropriate engineering and technology journals. Please source the individual authors for their work respectively, as drafts; some of these are still in a "report" type mode, but are being changed into formal manuscripts. These manuscripts had to be included as they are one variable in the program research and evaluation design.

Portfolio Notes for USE or REPLICATION

1. This Portfolio contains
    a. Complete Faculty Development Program: Although the program was developed to use with engineering and technology faculty, the teaching, student assessment, and learning program components as well as the educational research components are "generic" and can be used without change with any discipline.
    b. Instruments, Feedback and Evaluation Forms, Program Worksheets: These, as well, can be used without change with any discipline.
    c. Research Designs, Methodology, and Procedures: For (a) the faculty development program research and evaluation, (b) the classroom implementation of teaching models, assessments, etc. and (c) the experimental classroom research on student learning, the designs, methodologies, procedures, and process for research and evaluation can be used, without change, with any discipline.
    d. All data and reports are transparent. The organization, strategies, reporting style, process, and procedures will work with any discipline.
    e. Presentations: These will also work with any discipline.
    f. Faculty Products: Throughout each section in Data and Reports (B.1-14) faculty artifacts are included. Sometimes there are examples of all faculty products related to the program component; sometimes there are several, rather than everyone's. The intent was to reflect the quality of work, the diverse styles and responses to development, and the range of quality – although that did not vary greatly; they all performed well.

2. In all of our work on teaching and learning, regardless of whether secondary or post-secondary, we are firmly committed to the role that general education plays as a critical foundation. Of course, everyone would probably acknowledge that point and believe that learning in the majors extends and deepens the learning of those general education disciplines. We further believe that learning in the majors is merely an extension and deepening of the learning of the general education disciplines within the major context. This is not to dismiss that the major disciplines have their own bodies of knowledge, but the two are so deeply integrated that they cannot truly be separated. Therefore, you will find, whether in our work with secondary schools or post- secondary instructors and professors, that we overtly address the contributing general education disciplines equally alongside the engineering and technology content. In our secondary work with teachers, you will note on the website below that we included English teachers as full partners. Math and science was a natural inclusion when focusing on engineering and technology, but English, history, social science, and other disciplines have often been partners in our math, science, and technology interdisciplinary teams.

    For the work herein, we have made it very clear that in any effort to improve undergraduate education in the majors, one must overtly consider and attend to the continued and deepened learning regarding general education disciplines, as they are the fully integrated foundation for any undergraduate major. You will see that revealed in our process for analyzing and rebuilding or developing courses and student assessments.

3. In several places throughout the Portfolio, for reader convenience, partial pieces of other sections are copied and inserted. This eases reader frustrations because when considering a topic, everything is available in that particular section. For example, teaching models are addressed both in Course Analysis and its section on GAPS Analysis. However, Teaching Models is a major topic and section on its own. Therefore, we copied the related materials from the Course Analysis (B.5) and its subsection (GAPS Analysis, p.21) into the Models of Teaching Section (B.11), which has other data and reports included. This also occurs with Test Analysis and Development. As with Models of Teaching, it was an aspect of the earlier program component, Course Analysis (B.6), but also an equal program component and was completed in the Student Assessment Program component (B.9). Therefore, that report was copied into B.9 as a subsection.

4. Teaching and learning across all levels of education are similar. If you are interested in the work we have done with secondary math, science, technology, and English interdisciplinary teams, see strategicalliance.niu.edu. This website/electronic book is a similar type of document as this one. It provides all program content and information for a 21 day program with secondary teachers, the research and evaluation, and full literature, etc. (Scarborough, 2004, American Association of Higher Education). AAHE has disbanded; however, the full CD is available for download at the above website.

5. Finally, when reading the program description (A.3) or Data and Reports (C.1-14), if there are any instruments, forms, or worksheets that could be useful, Section C.1-21 makes them available in full format.

INTRODUCTION

Jule Dee Scarborough, Ph.D.

This Portfolio is nontraditional in that it combines a learning paper approach with a literature study, the presentation of two interdependent research endeavors, design and methodology, results, full program content and process, evaluation, and our conclusions , recommendations, and many product samples. We are presenting a selected cross section of the literature on or related to the scholarship of teaching for our faculty research participants, a more efficient and less redundant way of moving faculty forward in a timely manner than if we expected each person to produce his/her own version of a literature study. We are also using this method to present what is most illuminating, informing, or relevant to our interests.

The research and development aspects have two foci: (1) The Effectiveness of a New Faculty Development Model and Program on Teaching and Student Learning in Preparing Faculty for the Scholarship of Teaching and (2) Experimental Classroom Research on Teaching and Student Learning as The Scholarship of Teaching.

Background

The College of Engineering and Engineering Technology (CEET) at Northern Illinois University (NIU) consists of four departments: three engineering and one technology. It has five accredited programs, either by the American Board for Engineering and Technology (ABET) or the National Association for Industrial Technology (NAIT). The programs are electrical engineering, industrial engineering, mechanical engineering, electrical and manufacturing engineering technology, and industrial technology. The College transformed from a very large and multifaceted department of industrial technology, with a proud history of teacher education, into the newly structured college in 1985. The Department of Technology had already accomplished its first new era when its programs evolved beyond teacher education to meet the needs of industry with two degrees, education and technology, 13 areas of emphasis, and approximately 1500 students.

The first years of the second new era, beginning in 1985, were spent recruiting faculty; designing, redesigning, and developing programs; developing laboratories; modifying the interim building; designing and acquiring funds for a new building; and of course, becoming accredited. Approximately five years later, we moved from the interim building into a new building, while maintaining technology programs in the historical building. The second stage of that era, of becoming a more research and development-oriented college, has now begun. Although research and development have been ongoing, new goals have been established for the college, and stronger administrative leadership and support for faculty to develop and engage in research and development is now in place. In addition to seeking funding for research projects from the well known and traditional sources, such as the National Science Foundation, the college has prioritized and moved forward successfully through research and development partnership contracts with business and industry.

The Department of Technology continued to have a teacher education degree until 1995, and even though the degree was terminated at that time, the department has sustained a strong commitment to working with schools to strengthen mathematics and science education, with an external funding record of over nine million dollars in grants from federal and state agencies as well as significant private industry contributions. Although the focus of the K-12/14 was primarily secondary teaching and student learning, that history, record, and Boyer's (1990) national call to action for the scholarship of teaching at the university level lead us now to internalize all that we have researched and learned about teaching and student learning at the secondary level into a local call for action by the college, one that will focus on research and development of teaching and learning at the higher education level in engineering and technology. Our endeavors will be informed by and reflect the philosophy and definitions offered by Boyer, as well as Glassick, Huber, and Maeroff (1997) and Braxton (1996). Boyer also informs us, beyond our present consideration of the scholarship of teaching, about the other types of scholarship where faculty potential can be realized. He fully defines each one. His work helps us to reconsider our research goals and what the whole schema for research in the college might include. Many in higher education are familiar with the ideals and thoughts of these authors, and of the authors to be mentioned throughout the entire portfolio. Therefore, as we are beginning a new college adventure into the scholarship of teaching, while continuing to build and expand research in the traditional areas and in developmental partnerships with industry, it is important for us to inform our immediate participants and to present our vision, mission, and goals. While implementing our own ideas, we respectfully acknowledge all the ideals, thoughts, and work of others who inform or confirm our directions and interests.

Leadership

In an effort to model peer leadership, recognize the significance of the secondary education successes on teaching and learning, and positively exploit our own expertise, the dean of the College supported a college peer and distinguished professor as the primary leader of this initiative. As the leader of the College, the dean is vested in moving the faculty roles and functions to a broader arena, and fundamentally believes that teaching and research are equal and interdependent and that the college cannot accomplish its mission without equal attention to both teaching and research. Therefore, the Scholarship of Teaching is a natural endeavor for the college philosophically as it extends and deepens the teaching focus, also extending research into another area and leading us to implement Boyer's (1990) research model as the college model. The dean is committed to leading change in our bylaws, if necessary, that reflect the acceptance of the Scholarship of Teaching as an area of research to be as equally valued for promotion and tenure purposes as ongoing discipline-based research, pure or applied. It is entirely possible that, because of our historical acceptance of K-14 research towards promotion and tenure, confirmation of its equality will be all that is needed. Therefore, this initiative was conceived, theoretically and conceptually, and directed by one of our own faculty members (Burns, 1978).

The CEET Initiative on Teaching and Learning (CITL) is based upon the following:
CEET Vision: To build a regional and national reputation for The Scholarship of Teaching.

CEET Mission: To build (and continue to expand) an interdisciplinary team of faculty who understand the four types of scholarship as defined by Boyer (1990); have the ability to engage in either or several of the types of scholarship; and are stimulated to engage in scholarship activities, especially research on teaching and student learning, in their disciplinary classrooms.

CEET Promotion and Tenure Objective: To review what constitutes acceptable scholarship across its departments. To confirm that research productivity across the types of scholarship, as defined by Boyer (1990) and including The Scholarship of Teaching, is as equally acceptable for promotion and tenure purposes as the research of discovery, integration, and application.

CEET Goal for Faculty: To engage in scholarship of teaching either as, or alongside of other, scholarship interest(s).

CEET Scholarship Quality Goals: To adopt standards for quality performance in scholarship (Glassick et al., 1997). This goal will not be addressed in the pilot initiative.

CEET Faculty Development Goal: To design, develop, pilot, institutionalize, and sustain a program of faculty development on teaching, student learning, student assessment, and educational research to prepare faculty to engage in scholarship of teaching through experimental and/or action research in the classrooms.

CEET Goal for Students: To develop learners in the truest sense, meaning that students leave with such excitement about what they have learned that they continue to seek to learn, extending what they learned with us into new meanings in their new experiences and opportunities throughout their careers. We want our students to understand the philosophy that learning stimulates learning; each original lesson continues to grow, change, expand, and take on different, broader, and deeper meanings as they navigate through various career, personal, and/or additional learning events or contexts.

Faculty Participants

A group of three teams, two faculty members from each of three departments, and one faculty member from the fourth department (lost one faculty member) working together engaged in professional development on student learning, teaching, student assessment, and educational research. The initiative focused on two parallel, but inseparable, research aspects – the development of faculty leaders on teaching and learning followed by classroom research on the effectiveness of selected teaching and assessment strategies on student learning. Once the faculty members completed the professional development program, they continued into the classroom to engage in formal experimental research to evaluate the effectiveness of selected strategies. This experimental treatment data was

compared to control group data collected prior to the professional development and classroom research. The research methods were both quantitative (experimental) and qualitative, as student achievement and other types of data were collected throughout the initiative. In addition, the faculty development program and model were evaluated. Therefore, the research was comprised of two primary foci: faculty development and the effect of selected teaching and assessment strategies on student learning – our first attempt to execute the Scholarship of Teaching through classroom research at the university level in our college.

Beginning very focused, the faculty development program engaged faculty in 18 days of the following modules: (1) cognitive learning, models, and processes; (2) connecting national standards to course and student learning objectives, outcomes, and student assessment; (3) evidence of learning; improving traditional testing and measurement, and continuing on to connect tests to performance assessment – the development of performance tasks and corresponding rubrics; (4) teaching models; and (5) educational research. This program, content, and process is explained in detail in Section A.5.

Pilot Initiative Outcomes
(also see Faculty Development Program Outcomes in Section A.5)

1. Faculty development model, program, and process;
2. Research and evaluation of the faculty development model, program, and process;
3. The Scholarship of teaching through experimental classroom research;
4. Classroom research results to guide teaching and learning decisions and base further research upon;
5. The redefinition of the relationship of teaching to research with the confirmation of (or if needed, the adoption of modified) bylaws that will reflect the four areas of scholarship as those proposed by Boyer (1990): discovery, integration, application, and teaching.

Products

1. CEET faculty professional development model, program, and outcomes portfolio
2. Faculty leadership team(s)
3. Classroom or student learning research results
4. New or revised Teaching/Learning educational products (e.g., student assessments, syllabi, models and processes, feedback instruments, and others)
5. College Portfolio to be submitted to the ERIC
6. National mailing to all engineering and technology schools with portfolio enclosed
7. Research Manuscripts to submit to national publications
8. National presentations
9. Proposals for ongoing research

10. Proposals to modify faculty evaluation procedures to include scholarship of teaching as an acceptable form of research towards promotion and tenure; this will not occur until the second stage of the Initiative.

Phases and Timelines

Preparation – January - December 2005 - Background research and preparation

Program and Research

1. February 2006 - May 2006 - Pilot professional development model and program
2. August 2006 - December 2006 - Research on teaching and learning strategies in classrooms; conduct experimental research
3. January - February 2007 - Evaluation; data collection, processing, analysis, interpretation; publication preparation
4. 2007 - 2008 - Dissemination
5. 2007- 2008 - Submit changes in the bylaws related to scholarship (if needed) or acknowledge formal confirmation that The Scholarship of Teaching is as equally accepted for promotion and tenure as other types of research.

Sustainability

1. Modify faculty development model, program, and process based upon evaluation results
2. Modify courses based upon research and feedback of 2006 research semester
3. Redesign classroom research based upon research results
4. Engage in round two of program and research
5. Institutionalize and sustain faculty development program and faculty classrooms research with annual evaluations and updates

Operational Objectives

Faculty development

1. To prepare faculty to engage in the Scholarship of Teaching and its inherent research agenda
2. To prepare a faculty team to lead the Scholarship of Teaching in the college
3. To engage faculty in a program of professional development on teaching and learning and educational research

Research

1. To evaluate the effectiveness of the professional development program
2. To study the effects of selected teaching and learning strategies on student learning through formal experimental classroom research
3. To study the effects of improved traditional testing in conjunction with performance assessment

Quality Improvement

1. To strengthen teaching and student learning across CEET
2. To extend research beyond traditionally accepted definitions of research for engineering and technology professors in the college, adding the Scholarship of Teaching
3. To build confidence in the value and role of teaching as a primary and welcome responsibility of our professoriate;
4. To build confidence in the value and role of research on teaching and learning – the Scholarship of Teaching – and include it equally alongside the other types of research across the college.

Evaluation

1. Faculty development model, program content, and processes
2. Classroom research results
3. Outcomes
4. Educational products

Dissemination – nationally through American Society for Engineering Education (ASEE) & NAIT conferences and journals; EE, IE, ME, IT journals and Portfolio

1. Faculty development model, program content, and processes
2. Classroom research results
3. Evaluation of faculty development program
4. Faculty improvement results

CEET Promotion and Tenure Policy and Procedures

1. To confirm that the Scholarship of Teaching is acceptable research for promotion and tenure or, if necessary, submit bylaw content changes to include the Scholarship of Teaching
2. To make faculty aware of confirmation of acceptance of the SoT, or
3. To implement new bylaws

The Relationship between Research and Teaching

The seminal work by Boyer (1990) led the Carnegie Foundation to engage in the Ernest L. Boyer Project of the Carnegie Foundation for the Advancement of Teaching. Boyer raised the issue of how faculty spend their time and what they are rewarded for doing. This led to the question: "what activities of the professoriate are most highly prized… [noting] that it is futile to talk about improving the quality of teaching if, in the end, faculties are not given recognition for the time they spend with students?" (p. xi). He traces the debate throughout history, illuminating the transitions and shifting priorities of American higher education, noting that students are often the losers and further noting that students

> are assured that teaching is important, that a spirit of community pervades the campus, and that general education is the core of the undergraduate experience….but the reality is that, on far too many campuses, teaching is not

> well rewarded, and faculty who spend too much time [working with students] may diminish their prospects for tenure and promotion. (p. xii)

Boyer's (1990) goal in this work is to "break out of the tired old debate and define, in more creative ways, what it means to be a scholar…recognize the full range of faculty talent and the great diversity of functions higher education must perform... [stating that] for American higher education to remain vital we urgently need a more creative view of the work of the professoriate" (p. xii). Most important in his introduction is his acknowledgement of the "need [for] a climate in which colleges and universities are less imitative, taking pride in their uniqueness…to end the suffocating practice in which [they] measure themselves…by external status rather than by values determined by their own distinctive mission" (p. xiii). He frames the question of better education in the context of how scholarship is defined and rewarded, trying to reflect what he and others consider the full range of academic and civic mandates, and describes four views of scholarship - "discovery, integration, application, and teaching," defining them as follows (pp. xii-xiii).

(1) Knowledge for knowledge sake - the creation of a bank of knowledge or information, ready to draw upon when the time for intelligence use arrives. (Thomas, 1977)

> <u>Scholarship of Discovery</u> comes closest to what academics [identify] as research…the freedom of inquiry and to follow, in a disciplined fashion, an investigation wherever it may lead….Not just the outcomes, but the process, and especially the passion, give meaning to the effort.
>
> [Boyer quotes] Bowen (1986), scholarly research reflects our pressing, irrepressible need as human beings to confront the unknown and to seek understanding for its own sake…tied inextricably to the freedom to think freshly, to see propositions of every kind in the ever changing light. And it celebrates the special exhilaration that comes from a new idea (p.17).…[T]he probing mind of the research is an incalculably vital asset to the academy and the world…the very heart of academic life…the pursuit of knowledge must be assiduously cultivated and defended…the discovery of new knowledge is absolutely critical. (pp. 117-18)

(2) Authenticating knowledge through analysis and interpretation, establishing meaning or original research through interdisciplinary consideration and synthesis.

> <u>Scholarship of Integration</u> - the need for scholars who give meaning to isolated facts, putting them in perspective…making connections across the disciplines… serious, disciplined work that seeks to interpret, draw together, and bring new insight to bear on original research.
>
> [Boyer quotes] Van Doren, "[t]he connectedness of things is what the educator contemplates to the limit of his [her] capacity." It is through connectedness that research ultimately is made authentic…closely related to discovery…where fields converge…[where one fits] one's own research – or the research of others – into larger intellectual patterns….Those engaged in discovery ask "What is to be

known, what is yet to be found?" Those engaged in integration ask, "What do the findings *mean*? and provide a …more comprehensive understanding…requiring critical analysis and interpretation. (pp. 18-21)

(3) Where scholarship connects theory and practice and proves its worth to the nation and world.

Scholarship of Application - How can the knowledge be responsibly applied to consequential problems? How can it be helpful to individuals as well as institutions? Can social problems themselves define an agenda…serving the interests of the larger community.

[When considering the following international perspective by Harper (1906)] … Scholarship…was regarded by the British as "a means and measure of self-development," by the Germans as "an end in itself, "but by Americans as "equipment for service." Self-serving though it [the American perspective] may have been, this analysis had more than a grain of truth…the gap between the academy and the needs of the larger world…service is routinely praised, but accorded little attention.

Colleges and universities have rejected service as serious scholarship, partly because its meaning is so vague and often disconnected from serious intellectual work…[e.g. projects, committees, etc.]. Clearly a distinction must be drawn between citizenship activities and projects that relate to scholarship itself….To be considered scholarship, service activities must be tied directly to one's professional activity…serious, demanding work, requiring rigor…[and] accountability…associated with research activities…The process we have in mind is more dynamic [where] new intellectual understandings arise out of the very act of application [where] theory and practice vitally interact, and one renews the other… both apply[ing] and contribut[ing] to human knowledge…[using] the skills and insights only the academy can provide…

Handlin observed our troubled planet "can no longer afford the luxury of pursuits confined to an ivory tower"…[where] scholarship has to prove its worth not on its own terms but by service to the nation and the world. (pp. 21-23)

Scholarship of Teaching - [where] the work of the professor becomes consequential….as it is understood by others…Today teaching is often viewed as a function…[however,] Aristotle said, "Teaching is the highest form of understanding."....beginning with what the teacher knows…steeped in the knowledge of their fields….One reason why legislators fail to understand why 10-12 hours in the classroom each week can be a heavy load is their lack of awareness of the hard work and serious study that undergirds good teaching,…a dynamic endeavor involving all analogies, metaphors, and images that build bridges between the teacher's understanding and the student's learning. Pedagogical [and adrogogical] procedures must be carefully planned and continuously examined…[According to] Palmer (1983)…knowing and learning

are communal acts. With this vision, great teachers create a common ground of intellectual commitment. They stimulate active, not passive, learning and encourage students to be critical, creative thinkers, with the capacity to go on learning after their college days are over. Further, good teaching means that faculty, as scholars, are also learners….[not] transmit[ting] information that students are expected to memorize and then recall…but *transforming* and *extending* it as well…Inspired teaching keeps the flame of scholarship alive…All academics credit good teachers…defining their work so compellingly that it became…a lifetime challenge. Without the teaching function, the continuity of knowledge will be broken and the store of human knowledge dangerously diminished.

Oppenheimer (1954) spoke…"The specialization of science is an inevitable accompaniment of progress; yet it is full of dangers, and it is cruelly waster, since so much that is beautiful and enlightening is cut off from the rest of the world. Thus, it is proper to the role of the scientist that he [she] not merely find the truth and communicate it to his [her] fellows, but that he[she] teach, that he [she] try to bring the most honest and most intelligible account of new knowledge to all who will try to learn…knowledge is acquired through research, synthesis, practice, and through teaching. (as cited in Boyer, 1990, pp. 23-24)

These four types of scholarship acknowledge the great range of talent and diversity within the professoriate. The creative tension between the above definitions stimulates us to appreciate scholarship from a broader perspective, each type contributing significantly to the other and ultimately to the development of humanity and its endeavors through the academy and other contributing institutions.

Also important to us is Boyer's (1990) point that there is a unique opportunity for comprehensive universities, one where we can establish our own unique missions rather than imitate the traditional research universities, the opportunity to blend quality with innovation, choosing the foci of our passion (whether Scholarship of Discovery, Scholarship of Integration, Scholarship of Application, or the Scholarship of Teaching) with the understanding that the Scholarship of Teaching is a requirement for knowledge to continue to expand and be used. We agree with Boyer that "diversity with dignity" (p. 64) is building a diverse learning system and learning organization where undergraduate and graduate learning are priorities; where the Scholarship of Teaching is honored and prioritized in conjunction with other types of scholarship; where they integrate, one not dominating the other; and where the diverse range is sought, sustained, and respected. Thus, not only is it mandatory that we move ahead to formally acknowledge the importance of the Scholarship of Teaching alongside the others, it also reaffirms and acknowledges the importance of the historical commitment to teaching and student learning in our service to secondary education and extends that work into our own engineering and technology classrooms at the university level in an informed manner, with an understanding of what our vision means, what will be required to attain it, and that the extension of knowledge rewards what will ensue. This vision attends to preparing students for their professions as learning individuals, integrating general and major

education more relevantly and overtly, strengthening capstone experiences, and ultimately examining the master's degree educational experiences to determine what needs to be sustained or strengthened. Most important is to establish a more productive relationship between teaching and student learning. Therefore, we engage in this initiative to actively explore that relationship through teaching and learning research. We will begin simply with a two-pronged, but interdependent, research initiative: the first research focus will be the design, development, and piloting of a new faculty development model and program to prepare a pilot group of faculty to actively engage in experimental research on classroom teaching and student learning; the second research focus will be the actual experimental classroom research on teaching and student learning (TL). Both of these activities will be rigorously evaluated to determine their value to inform the faculty and administration about what the next level of activities should be to sustain, expand, and deepen the Scholarship of Teaching initiative. As Boyer (1990) establishes, we have the opportunity to determine our own unique model and what is acceptable as faculty role, function, and responsibility. See Research Model and Faculty Development Model A5.

Wankat, Felder, Smith, and Oreovicz (as cited in Huber & Morreale, 2002) review the history of engineering research and education, showing the progression toward research on engineering education. They note that until the 1980s, it was a “we tried it and liked it and so did the students” approach (p. 217). When the National Science Foundation (NSF) began to fund educational research and development, more scholarship began to emerge. But the most significant catalyst may have been ABET’s *Engineering Criteria 2000*. The criteria required educational objectives, assessment measures, and the “closing of the loop” in which assessment results were tied to corrective actions where necessary. Although these new criteria do not require educational research, they did intensify interest in engineering education, assessment, and research. Faculty members are gradually realizing that changes in pedagogy are required if they are to achieve the outcomes specified by the criteria. More papers are being submitted on the scholarship of teaching to the engineering education journals because of the influence of the criteria.

Historically, only one of Boyer’s (1990) scholarships counted for faculty in the research area, that of discovery. However, NSF fostered collaboration across disciplines by recognizing that complex problems need interdisciplinary attention for meaningful solutions, which required a shift from single investigator to multidisciplinary centers. This helped to make the Scholarships of Integration and Application more legitimate for engineering. But the Scholarship of Teaching was still not of priority, and only a small number of faculty participated in ASEE; nor did the few papers on educational research reach many faculty in the mainstream. To stimulate more interest and research, NSF then began to support scholarship in engineering education through the Division of Undergraduate Education and the Coalitions program. This improved the status of educational research in engineering faculty’s performance reviews and began to move collaboration forward between engineering and social science professors.

At the heart of the matter, also mentioned in the Wankat et al. (as cited in Huber & Morreale, 2002) article, is engineering colleges and schools are realizing that engineering

(and in our case engineering technology and technology) faculty must be prepared to implement the teaching and assessment methodologies required to meet the new accreditation standards; thus, campuses are instituting faculty development programs and initiating faculty learning communities. However, there are challenges with the Scholarship of Teaching (and student learning) in engineering. Engineering research is much more scientific and developmental, whereas educational research is much less precise, as it is social science research. Controlling the experimental design is not as easily accomplished in a more social scenario.

The goal is to improve teaching and learning, but who can agree on what that means? What is learning: the acquisition of knowledge, deepening of understanding, improvement of both technical and interpersonal skills, development of desired attitudes and values – all subjective constructs. Defining them precisely is not that easy, especially in the engineering forms most commonly understood by engineers. Educational research cannot always be directly observed or calculated. Existence and development must sometimes be inferred from observation of students' behaviors, thus identification of the behaviors and rules of inference are controversial. Students are more difficult to categorize than transistors or fruit flies; the factors influencing learning (learning styles, personalities, knowledge and skills, what they bring with them (e.g., traits or home environments) are all somewhat subjective). Therefore, to establish a cause and effect relationship between a treatment and the outcome is difficult to demonstrate or replicate; to prove something, many studies have to be executed with large populations for generalization to be possible.

Engineers are not used to this level of involvement to determine a treatment effect. The reasoning is quite different, which builds skepticism that must be overcome to accomplish the scholarship of teaching and learning with engineers. Finally, Wankat et al. (as cited in Huber & Morreale, 2002) note that a metric (tools and procedures) has to be created to determine a value for system variables. In science and engineering proper, metrics and valid and reliable instruments to measure them are easier to identify than in education, which has been an obstacle for engineering education until recently. Engineering professors are becoming aware of teaching methods, classroom assessment techniques, and although still small, a growing number of engineering professors are engaging in formal research studies of different approaches to course design and delivery. They are still using mostly student surveys and end of course ratings because they are easy. These methods, however, lack credibility to achieve change with engineering professors on teaching and learning.

Although there are published experimental studies, they have their own set of obstacles; engineering classes are small, making it difficult to have the numbers for both experimental and control groups and to achieve statistically significant results. We, however, do not always agree with that premise. Engineering professors are unfamiliar with the complexities and ethical issues when involved with human subjects and with the planning that has to be accomplished prior to the studies. It seems that innovations in engineering education usually develop through a natural growth and change process, not as often from pre-planning. Therefore, most of the studies reported in the *Journal of*

Engineering Education are rigorous in their quantitative methods. Some have methodological weaknesses, perhaps with the exception of research on cooperative learning (Johnson, Johnson, & Smith 1998a, 1998b, 1998c; Springer, Stanne, & Donovan, 1999). Qualitative research is making its way into engineering education, mostly about retention, but as faculty members realize that some of the ABET 2000 criteria relate to skills that can be assessed through qualitative methods, that will gradually change. When assessing educational scholarship in engineering, most engineering professors feel they know high quality research. But when considering the Scholarship of Teaching and Learning, they are not sure that it can be evaluated with as much rigor; learning that it can will be essential in making it acceptable criteria for advancing up the engineering faculty ladder for tenure and promotion. Felder (2000) presents three primary questions to use when considering the promotion of a professor in engineering:

1. To what extent does the instructor's teaching qualify as a scholarly activity?
2. How effective is the instructor's teaching?
3. How numerous and effective are the instructor's educational research and development efforts? (pp. 230-31)

Felder (2000) goes on to suggest the data to use when evaluating these questions:

1. <u>Archival data</u>: lists of courses developed and taught, instructional materials, student products, student numbers, etc.
2. <u>Learning outcomes assessment data</u>: test results, evaluations, student self-assessments, etc.
3. <u>Subjective evaluations by others</u>
4. <u>Self-assessment data</u>: teaching philosophy, goals, progress, etc.

He offers an educational scholarship assessment protocol. If we are to legitimize the Scholarship of Teaching and Learning in the academic system for engineering educators, then we must integrate it into the reward system. However, this is an issue when the financial support for the Scholarship of Teaching and Learning is weak, making it difficult to get funding. And we all know what grant funding does for us! (In 1999, 72 papers were published in the *Journal of Engineering Education*: 65% had no funding; 19% had some funding from NSF; 8% were funded by professors' universities; and 3% by the Federal Fund for the Improvement of Postsecondary Education.) Thus, the funding for engineering scholarship on teaching and learning is somewhat minimal. There is an essential need for multidisciplinary collaboration with non-engineers if we are to achieve a professional level of activity. For example, the *Journal of Engineering Education* cited many non-engineers, and NSF has funded most major grants with co-principal investigators who are not engineers. This is positive, however, for engineers are not trained in educational research, ethnographic methods, the construction of qualitative measures; they do not have the interpretative skill or experience with the broader range of assessment methods. Collaboration will bring more appropriate knowledge, skill, and background to the Scholarship of Teaching and learning in education. And engineers have a great deal to offer their non-engineering counterparts – their understanding of instructional technology for example. But multidisciplinary collaboration and research have its difficulties as well. Their "differentness" is obstacle enough sometimes: their

concept of research, their priorities, vocabularies, and ability to be team members on research. However, the partnerships between engineers and non-engineers/technologists and rewards can be great. Thus, the purpose and reasoning underlying our initiative.

Figure A.1.1: CEET Scholarship of Teaching Learning Community Model

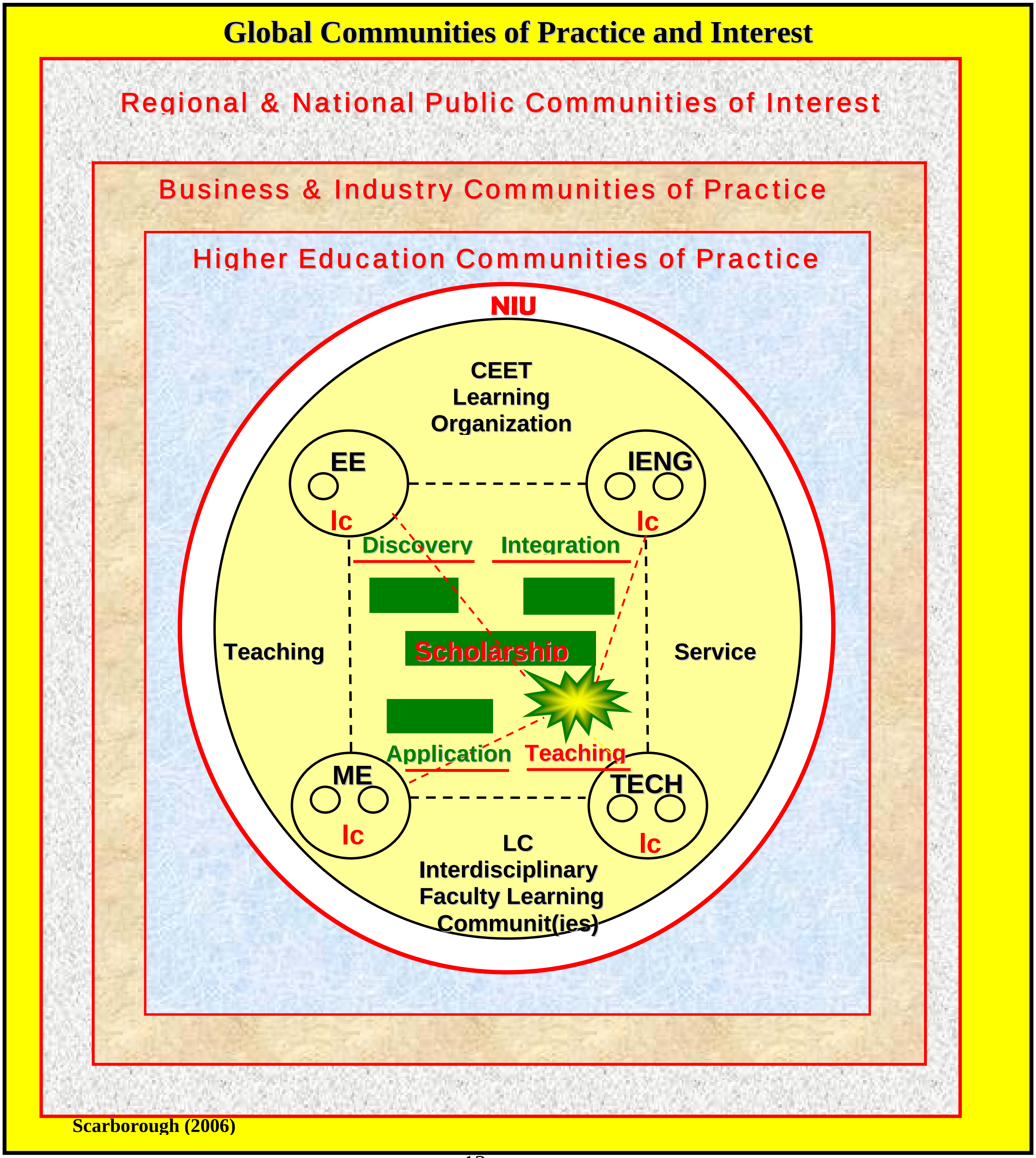
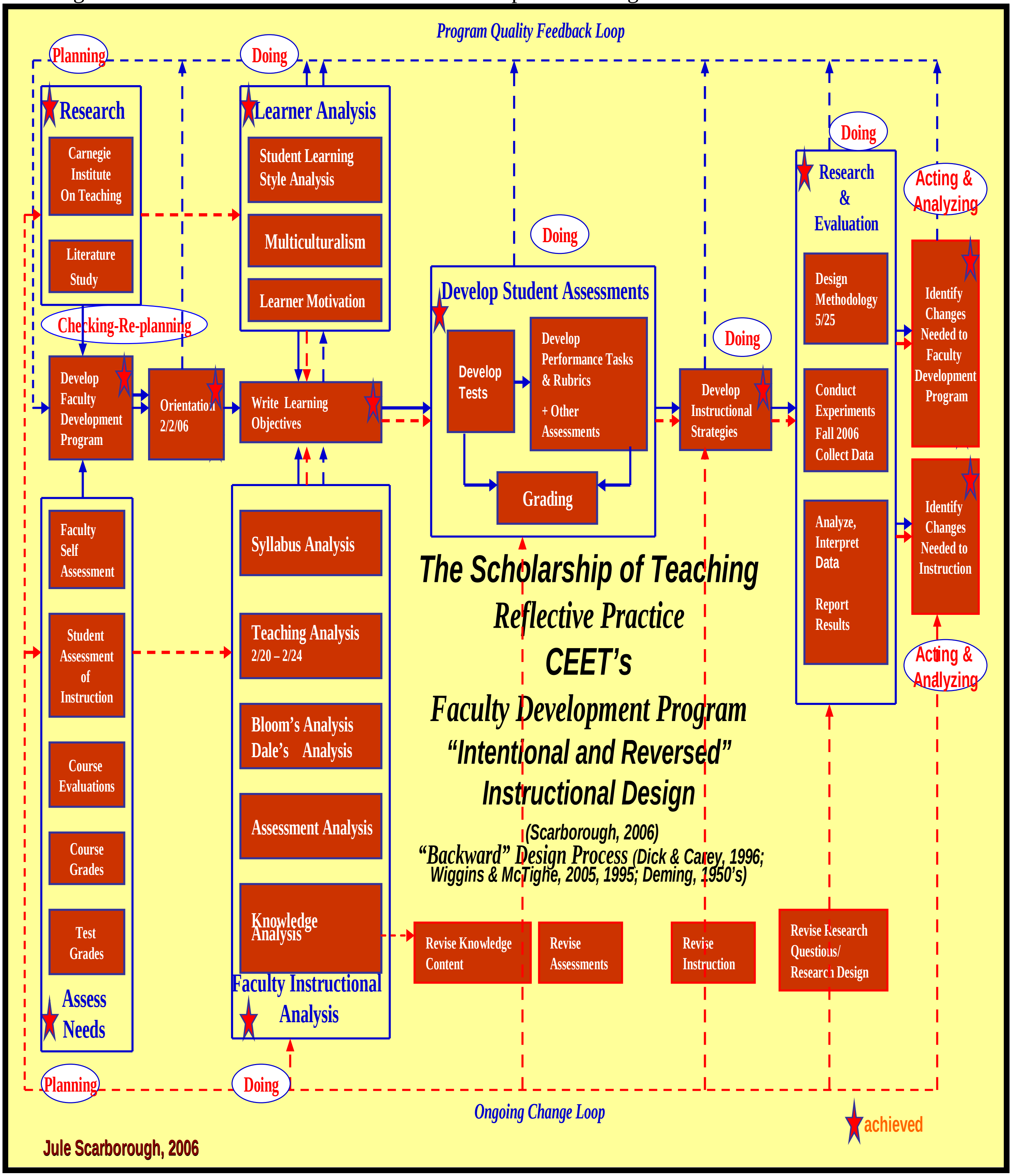


Figure A.1.2: Reflective Practice: The Scholarship of Teaching – The CEET Model



The Scholarship of Teaching – Executive Summary

CEET INITIATIVE ON TEACHING AND LEARNING (CITL)

Pilot Results

College Portfolio

May, 2007

Jule Dee Scarborough, Ph.D.

The Results Summary presents the overall accomplishments of the Initiative, as well as any important notes or changes, and describes all educational products produced. It is organized into the following four sections. Each section includes a brief narrative summary followed by a chart that itemizes each objective, goal, or outcome; these are followed by descriptions, progress to date, quality comments, challenges or issues, and future directions or changes.

1. Vision, Mission and Operational Objectives
2. Faculty Development Program and Faculty Research
3. Faculty Development Program Outcomes:
4. CITL Faculty Participant Teaching Portfolio Summary

1. Vision, Mission and Operational Objectives

Visions, and vision statements, are not short term in nature. But any initiative can generally report progress toward attaining a vision. However, since visions are always a "future state" and are "living" and "dynamic," they should be continuously modified to reflect higher goals of excellence, each time raising the standards to achieve something more. The CITL vision to become a regional and national leader for the Scholarship of Teaching is a major and complex vision to achieve. The immediate mission to begin to move towards achieving the vision is one of creating a faculty learning community (LC) that is prepared to engage formally in the Scholarship of Teaching. Therefore, we began with a pilot initiative that formally involved a small group of faculty members (7) in a very intense and extended faculty development program to prepare them for the Scholarship of Teaching – formal experimental classroom research. In reviewing the chart that follows, readers will see that we have made the expected progress toward each objective, exceeded many objectives and goals, and now understand what will be required to implement the faculty development program and the Scholarship of Teaching more broadly across the college and its four departments. We are exactly where we hoped to be at the current time: an interdisciplinary and functional engineering and technology faculty learning community. The LC has successfully completed all aspects of the program and engaged in one semester of formal experimental classroom research on teaching, student assessment, and learning, for which each member has prepared a research manuscript to submit for publication. The Dean and Faculty Learning Community are planning how to sustain their accomplishments (what changes to make), how to extend the LC and its learning and research, and how to disseminate information regionally and nationally (including writing proposals for additional funding). The chart below itemizes and describes the status of each aspect of vision, mission, and operational objectives and goals, pages 2-4. (See Portfolio Introduction, Section A.1)

Legend:
! Achieved/Excellent
√ Achieved well, or + Moving appropriately towards
P Partially Achieved
N Not Achieved

Table A.2.1: Mission, Vision, and Operation Objectives

Type	Description	Progress towards ultimate Outcome and Timeline		Products	Notes	Future Direction & Changes
Vision	*To build a regional and national reputation for the Scholarship of Teaching. Begin by motivating an interdisciplinary learning community of faculty to own and interpret the vision.*	**Faculty learning community of 7 professors created and functioning well.**	+ ! N	See College Portfolio Sections		1.Phase II of development for original LC 2. Create second CEET LC
Mission	*To build (expand and sustain) an interdisciplinary team(s) of faculty who understand the four types of scholarship as defined by Boyer (1990); have the capability of engaging in either or several of the types of scholarship; are stimulated to engage in scholarship activities, especially research on teaching/student learning, in their disciplinary/ interdisciplinary classrooms.*	**Pilot completed.** **One faculty LC in place with all goals achieved for all but one faculty member.**	!	See College Portfolio Sections	Need to deepen and sustain the LC so that the faculty can continue to a phase II of learning and deeper commitment to LC and the four scholarships.	1.Phase II of development for original LC 2. Create other CEET LCs
Operational Objectives						
1. Faculty Development	*1. To prepare faculty to engage in the Scholarship of Teaching and its inherent research agenda.* *2. To prepare a faculty team to lead the Scholarship of Teaching in the college.* *3. To engage faculty in a program of professional development on teaching and learning and educational research.*	**Completed well** **Completed program to date** **Completed well**	! ! √	See College Portfolio See Program Descrip-tion	1. Accomplished well; they wish for more development to extend and deepen understanding/ capability 2. Several are committed to leading the LC; all desire to continue in LC. 3.Six of seven completed every aspect of the program and experimental research; one completed almost everything.	1.Plan and pilot Phase II of development for original LC 2.Establish sustaining LC leader(s) 3. Determine LC activities
2. Research	*1.To study the effectiveness of the professional development program* *2. To engage in the Scholarship of Teaching and study the effects of selected teaching and learning strategies on student learning.* *3. To study the effects of improved traditional testing in conjunction with performance assessment.*	**Formal evaluation provided strong evidence of success.** **All professors executed formal experimental classroom research.** **Qualitative evidence and professors response to performance assessment was extremely positive.**	! ! √	See College Portfolio See Individual Professor Research See Individual Professor Research	1. Professors made serious and significant changes in courses, teaching, assessment, and more. 2. Professors learned more about the difference between experimental research in engineering and technology and that of education as social science research. 3. Professors responded positively regarding professional development on test analysis and the development and use of performance assessment, tasks/ rubrics.	1.Plan and pilot Phase II of develop ment for original LC 2.Establish sustaining LC leader(s) 3. Determine LC activities 4. Initiate second faculty LC 5. Offer program for other LCs

Legend:
! Achieved/Excellent
√ Achieved well, or + Moving appropriately towards
P Partially Achieved
N Not Achieved

Type	Description	Progress towards ultimate Outcome and Timeline		Products	Notes	Future Direction & Changes
3. Quality Improvement	*1. To strengthen teaching and student learning across CEET.* *2. To extend research beyond traditionally accepted definitions of research for engineering and technology professors in the college.* *3. To build confidence in the value and role of research on teaching and learning –the Scholarship of Teaching and include it equally alongside the other types of research across the college.*	**Pilot was successful** **End of course evaluations were approximately the same, but it is too soon to expect significant change on those; they were not a variable.** **Student responses on end of course questionnaire showed significant change in responses at .05 positive** **Faculty executed formal, experimental classroom research on teaching/learning** **Faculty LC is interested in continuing the Scholarship of Teaching and the interdisciplinary LC** **Faculty would like additional professional development**	+ ! + ! +	**See Course Analysis Products and Results** **See Research Models**	This goal is one that will take time to achieve; it is clear that the 7 professors involved in this initiative had introduced and implemented use of new teaching and learning strategies, teaching models, styles; they have stimulated additional student learning styles; new tests and performance assessments were administered for student assessment; also they have fully executed experimental classroom research on teaching and learning. They consider research on teaching and learning equal to that of discipline specific research.	Revise program for faculty preparation Expand classroom research by existing LC and future LCs Further support the Scholarship of Teaching by Dean and Department Chairs Reward for promotion and tenure
4. Evaluation	*1.To evaluate the* *a. faculty development model, program content, and processes* *b. classroom research results* *c. outcomes educational products*	**Feedback and evaluation of program excellent** **Experimental classroom fully executed** **New educational products excellent**	! ! !	**See Final Reports**	All aspects of the faculty development model and program were evaluated; classroom research was evaluated; and all educational products were evaluated by program leaders.	Review and revise program; Extend research; Continue evaluation
5. Dissemination	***1.*** *To disseminate nationally:* *a. faculty development model, program content, and processes* *b. classroom research results* *c. evaluation of faculty development program* *d. faculty improvement results* *2. products through* *a. ASEE & NAIT conferences and journals* *b. EE, IE, ME, IT journals* *c. portfolio (monograph)*	**Complete program, research, results, and evaluation will be available on CD with Explanation:** **Submitted to ERIC** **Sent to all engineer-ing/technology colleges** **Faculty submitted manuscripts to journals for publication on individual classroom research.** **Manuscript submitted by Dean on initiative**	! ! ! ! +	**See Products in College Portfolio**	To be completed during Summer 2007.	Will design national workshops and seek funding for participants from NSF

Legend: ! Achieved/Excellent
√ Achieved well, or + Moving appropriately towards
P Partially Achieved
N Not Achieved

Type	Description	Progress towards ultimate Outcome and Timeline		Products	Notes	Future Direction & Changes
6. Promotion & Tenure related to Research: **<u>Scholarship of Discovery</u>** **<u>Scholarship of Integration</u>** **<u>Scholarship of Application</u>** **<u>Scholarship of Teaching</u>**	*To redefine scholarship across its departments and make acceptable for promotion and tenure purposes, <u>either</u>, <u>or</u> <u>a</u> <u>mix</u>, of research productivity across the types of scholarship as defined by Boyer (1990).* *1. To submit bylaw content changes to include the Scholarship of Teaching* *2. To review and seek faculty approval on changes* *3.To implement new bylaws* ***We determined that seeking a change in the bylaws was not necessary to confirm acceptance of the Scholarship of Teaching toward promotion and tenure, merit, and academic reviews leading towards rewards. The College confirmed it as acceptable.*	**College Personnel Committee confirmed equal status of Scholarship of Teaching alongside other 3 types of research towards promotion and tenure.** **Departmental Chairs confirmed equal status of Scholarship of Teaching as above.** **Therefore, no need to seek bylaw changes.**	+ √	**Memos from Dean, Department Chairs, and College Council (Personnel Committee)** **Summer 2007**	Educational Research with K-12 teachers has historically been valued for tenure and promotion. The bylaws do not restrict professors on the choice of research; all research types, including that on teaching and learning, have been confirmed as valued towards tenure and promotion. We found we did not have to rewrite the bylaws.	None needed
Faculty Goal	*To engage in Scholarship of Teaching, <u>either</u> <u>as</u>, <u>or</u> <u>alongside</u> their other, scholarship interest(s).*	**Accomplished; See Research Results**	!	**Manuscripts; Research Data**		Continue by expanding research
Scholarship of Teaching Goal	**To adopt standards for quality performance in scholarship;* *(Finished)To include the Scholarship of Teaching as an equally acceptable type of scholarship alongside the other types of scholarship, discovery, integration, and application. (Boyer, 1990; Glassick et al., 1997).*	**Research Quality Standards not yet achieved.** **Equal status for Scholarship of Teaching confirmed.**	N !		*This is planned for the next phase. Not yet introduced; Will occur now that SoT is confirmed as acceptable.	**Primary Objective for second phase: 2007-2008**
Faculty Development Goal	*To design, develop, pilot, institutionalize, and sustain a program of faculty development on teaching, student learning, and educational research to prepare faculty to engage in scholarship of teaching through experimental or action research in the classrooms.*	**Faculty Development piloted; Program evaluated as excellent** ***Planning Sustainability & Institutionalization**	! + * N	**Program Materials, Presentations, Worksheets, References, Handouts, Inventories, Feedback & Evaluation Forms, etc.**		**Revise program and continue to offer for new LCs**
Student Goal	*To develop learners in the truest sense, meaning that students leave us with such excitement about what they have learned that they continue to seek to learn,*	**Analysis and redevel-opment of courses improved content, assessment, teaching; students responses on questionnaires positive**	+ N	**Course changes (e.g., syllabus, models, etc.)**	Long term goal that began with this initiative.	**Incorporate course assessments into research**

2. Evaluation of Faculty Development Program and Faculty Research

As described throughout the Introduction, Program Description, Research, and Results sections of the Portfolio, two prongs of research and evaluation are clear. The first prong of research and evaluation focuses on the Faculty Development Program that served as the vehicle to prepare faculty members for the Scholarship of Teaching. However, because our ultimate goal was to design and develop an integrated program for faculty development, where theory, models, strategies, processes, techniques, and procedures for teaching to increase student learning were woven together into a program rather than separated workshops, we decided the program could be research in itself, as the model, processes, and content were implemented differently than usual for a university level faculty development process. Therefore, we structured the study of the program as formal research and evaluated it formally.

Another critical aspect of our strategy was that the classroom implementation of new teaching and learning strategies and the experimental research both be an integral component of the faculty development program; therefore, the program took professors from building a foundation on teaching and learning through product development, new instructional choices about models and strategies, and into the classroom for implementation. Educational research was also a program component of the faculty development program and prepared the faculty for an initial attempt at experimental research in the classroom. It was important to include the actual engagement of classroom research as one of the program components to also follow into the classroom. Therefore, research was designed, methodology and procedures were determined, and the professors engaged in their first attempt at formal experimental classroom research during the implementation and "research semester" as a program component.

We learned many lessons as a result of our history of providing professional development for math, science, technology and English teachers, so we applied those lessons to higher education. (See strategicalliance.niu.edu.) For example:

1. Separated workshops without support to follow through with classroom implementation usually result in fewer actual changes in instruction or teaching and student learning in the classroom.
2. Our programs with teachers were usually 18-21 full days, followed by supported classroom implementation. Without what some would call extended time, very little understanding was realized.
3. Even following development with classroom implementation does not go far enough to ensure sustainability without "closing the loop" and engaging together to analyze what models, processes, strategies, new products, new practices were ACTUALLY implemented or used, and then discussing what worked and what did not, identifying changes for the next time, and formalizing those changes so instructional practices and decisions, or behaviors, continue to change and evolve.
4. Support is critical. Formal leadership is critical, as is follow up by leaders to ensure that results are documented, lessons learned are recorded, and dissemination occurs, beginning with LC members and then across LCs internally, regionally and nationally.

Faculty development is a complex and dynamic process. Program content is not easily determined, and good needs assessment and definition of the “current reality” are essential before determining a vision, the initial mission, and then the objectives or outcomes.

The chart below itemizes and describes each variable for the faculty development program research. The faculty members’ classroom research was one variable to determine the success of the overall faculty development program. Each variable is followed by its status to date, notes, and future changes. Consult the Research Section for more detail on the research methodology, procedures, and literature on faculty development programs. That section also more thoroughly discusses the individual faculty members’ research designs and results. (See Portfolio Sections A.3 and B.0-12)

Table A.2.2: Faculty Development Program and Faculty Research Results Summary

Type	Description	Status	Notes	Future Changes
Student End of Semester Questionnaire	Extensive questionnaire on all aspects of teaching and learning within student course context. Administered for 2005 course followed by administration in 2006 experimental course; Was used for comprehensive perspective.	2005 Significant difference at .05 level 2006 Significant difference at .05 level	It was developed to be comprehensive; therefore, it was extremely long. It was developed to be used as a bank of questions from which items could be chosen for more specific purposes. We choose to administer it, knowing that it was too long. Therefore, some would question the results for the 2006 administration. However, professors have faith that students took it seriously. This can be resolved by using it as a bank of questions from which to choose.	Use as a bank of items from which to choose for specific research focus and purpose.
Faculty (Student) End of Semester Questionnaire	Same questionnaire; we used it to see how the professors would respond, answering from the perspective of their students, about themselves. Timing same in 2005 and 2006 as students. Was used for comprehensive perspective.	2005 Significant difference at .05 level 2006 Significant difference at .05 level	Professors indicated that they took it seriously for both administrations.	Administer for same purpose and in same manner; Or they could complete the same abbreviated version, described above, as students, focusing only on particular research or items of interest.
Faculty Self Competency Questionnaire	Abbreviated and focused version of the full questionnaire above. Focus, however, was different. Professor viewpoint was to assess his/her own level of competency regarding knowledge and skills on teaching and learning.	2005 Significant difference at .05 level. 2006 Significant difference at .05 level	Worked well.	No changes suggested. Could be modified as needed for particular foci.
Program Content Knowledge Assessments	Pre- and Post-assessment of knowledge in each program component area.	Significant difference at .05 level	Worked well. Format and items seem to result in adequate and appropriate feedback to use to monitor program quality and faculty response to program and also to determine when to “tweak” program.	No changes suggested.
Program Feedback & Evaluation	Program Component feedback that collectively served as one aspect of program evaluation	Excellent	Professors were very pleased with the program and its results overall. They suggested shortening the program to fewer days, while also requesting more time on 1. Educational research 2. Add the following to program: a. formal student teaming b. student conflict & classroom mgmt.	Rework program to reduce 18 days to fewer days

Type	Description	Status	Notes	Future Changes
Student Assessment **Test Analysis**	Professors analyzed the 2005 midterm and final exams; identified strengths/weaknesses; used to develop new exams; Professors analyzed the new 2006 midterm and final exams used during experimental research semester	Analyses performed and used diagnostic-cally	Worked well. Use of analyses as diagnostic tools need to be strengthened; faculty members need to implement test analyses routinely, or at least periodically, to analyze quality of tests and instruction with goal of increasing student learning and ability to provide evidence of learning.	No changes suggested
Performance Assessments	No baseline analysis, as professors did not have performance tasks/rubrics. Each professor developed 3 complex performance tasks with corresponding rubrics and used them during the experimental research semester	Excellent	Worked well. Professors did review the results of using formal performance tasks and rubrics for the first time. They need to continue such a review, similar to test analysis above, for diagnostic purposes to determine what worked well and what needs to improve or change in the performance tasks, rubrics or instruction, to increase student learning and ability to provide evidence of learning.	No changes suggested
Professors' Teaching Portfolios	Each professor developed his/her teaching portfolio, which provided evidence of his/her learning and performance. The portfolio was used as assessment as learning	Excellent	Worked well; each professor has full documentation of what he/she learned, developed, and evidence of change and growth; the portfolio also provides a record of what he/she has yet to try, so it is a dynamic, living record where they continue to keep track of their evolution of the changes - e.g. teaching, instruc-tional practices, course content, research goals	No changes except to keep them going as ongoing records of learning, growth, and change; to set new goals
Professors' Research	Each professor engaged in the Scholarship of Teaching during an experimental research semester. Collectively, they experimented with new course structures; new syllabi; performance assessment; new teaching models. Individually, they researched particular aspects of teaching/learning specific to their individual interests.	Excellent as their first formal engagement in educational research in the classroom.	Worked well. Needs to be followed by further professional development on educational research and teaching and learning to deepen understanding and knowledge and skills on the Scholarship of Teaching. We did not build the variable – student knowledge gain on course content as a whole – into the research design. We felt we should have. Therefore, we suggested that faculty members develop a pre and post test for the course as a whole and administer it to determine knowledge gain for the course.	No changes suggested for first phase. Add a second phase to deepen knowledge and understanding. Add pre and post test for course.
Professors' Manuscripts	Evidence of each professor's Scholarship of Teaching in a research manuscript format; to be submitted to journals.	Fine for confirming formal classroom research	Manuscript quality ranged from excellent to approproprite drafts; 2/7 need more consideration, but documented the research fine. All professors need to close the loop by identify future changes and research questions. Some can be submitted to journals in current state; others need revision. But, all provided high quality evidence of the classroom research.	1. Close the Loop 2. Add literature to establish studen basis 3. Add literature to consider results
Standard Student Evaluations and Course Grades	Initially, we thought that we could use "change in student evaluations" and "course grades" as part of program research & evaluation. However, we did not for-mally include as variables.	No Status	Feel that these two variables should be incorporated in next round of program implementation and used as variables in research and for evaluation purposes.	Add and formalize

3. Faculty Development Program Outcomes:
4. CITL Faculty Participant Teaching Portfolio Summary

Although the chart below identifies all of the faculty development program outcomes that we desired to achieve, there are few notes or change comments. The program worked well; all outcomes were either achieved or exceeded. As a direct result of faculty members' dedication, commitment, and hard work, and their tolerance for the "ever expanding requests" to try something new as ideas evolved throughout the program, their list of accomplished outcomes is phenomenal. Also the quality of their work was outstanding, especially considering the number of products, complexity of products, and level of detail and tediousness of some of the analyses, which were then summarized into other culminating analyses. The analysis process, although appropriately scaffolding, could have seemed unnecessary and very much like a "Never Ending Story"; however, they did it ALL!!

The Outcomes chart immediately below presents the list of outcomes; these are described more completely, and with worksheets in the Program Description Section of the Portfolio.

The Outcomes Chart is followed by the CEET Teaching Portfolio Chart, which provides a list of each type of product or educational decision made by each professor. This is a culminating college chart reflecting the contents of the teaching portfolio for each professor who participated. The two charts reveal the breadth and depth of the program, all products, and/or instructional or behavioral decisions. There are minor changes, additions, or suggestions for the future, but overall everything was accomplished to, or exceeded, expectations. See Portfolio Sections A.5 and B.0-B.12.

Legend:
! Achieved/Excellent
√ Achieved well, or + Moving appropriately towards
P Partially Achieved
N Not Achieved

Table A.2.3: Faculty Development Program Outcomes

Outcomes		Status	Notes	Future Changes
I. To analyze each existing course to		Completed; Excellent	See Results in Analysis Reports	Reduce program component time
a. determine appropriate content knowledge for achieving ABET/TAC/NAIT standards or student learning outcomes		!		
b. determine knowledge content priority: major, secondary, other or minor		!		
c. determine how knowledge fits into Bloom's Taxonomy Knowledge Dimension		!		
d. determine the embedded general education goals		!		
e. determine appropriate teaching models and styles		!		
f. determine which student learning styles are being engaged		!		
g. determine the levels of Bloom's Taxonomy Dimension of Learning being achieved		!		
h. determine the levels of Dale's Cone of Learning being achieved		!		
i. determine strengths and weaknesses of the course		!		
j. determine strengths and weaknesses of instruction		!		
k. determine strengths and weaknesses of syllabus		!		
II. To analyze all tests to		Completed; Excellent	See Results in Analysis Reports	No changes
a. determine the overall quality of the test		!		
b. determine the overall quality of test items		!		
c. identify strengths and weaknesses of existing tests		!		
d. map test relationship to course outcomes		!		
e. map test items to course outcomes		!		
f. analyze other assessments for quality		!		

Legend:
! Achieved/Excellent
√ Achieved well, or + Moving appropriately towards
P Partially Achieved
N Not Achieved

Outcomes		Status	Notes	Future Changes
III. To redevelop course outcomes that directly link to ABET/ TAC/ NAIT a. redevelop the course outcomes and map relationship to ABET/TAC/NAIT b. break down outcomes in outline form: major, secondary, minor levels c. identify knowledge according to Bloom's Knowledge Dimensions d. identify embedded general education goals e. map outcomes to Bloom's Dimension of Learning levels f. map outcomes to Dale's Cone of Learning levels		Completed; excellent ! ! ! ! ! !	See Results in Analysis Reports See Course Syllabi Report reflecting content, schedule, outcomes, etc.	No changes
IV. To redevelop tests that directly link to course outcomes and ABET/ TAC/NAIT a. create a table of specifications b. develop a bank of diverse test items, multiple items for each outcome 1. multiple choice 2. true/false 3. short answer 4. matching 5.problems c. assemble two comprehensive tests 1. midterm examination 2. final examination		Completed; excellent ! ! ! !	See Portfolio and Results Report	No changes

Legend:
! Achieved/Excellent
√ Achieved well, or + Moving appropriately towards
P Partially Achieved
N Not Achieved

Outcomes		Status	Notes	Future Changes
V. To design and develop a more diverse and balanced student assessment plan		Completed; excellent	See Assessment Plans in Results Reports	No changes Next phase, broaden plan to include more assessments with grading criteria specified
a. develop 3 complex performance tasks with corresponding rubrics		!	Assessment plans became more multifaceted and balanced by redeveloping better traditional tests, better problems, but most importantly by adding the performance assessments and rubrics. Some also added other assignments as assessment more formally. Some did not. At this stage, adding/redeveloping the tests and adding and developing the 3 performance assessments and rubrics were the goals. Each professor also mapped the course assessment plan and connected each test, test item, and assessment and rubric criteria directly to student learning outcomes.	
1.task and rubric that correspond with the midterm exam		!		
2.task and rubric that correspond with the final exam		!		
3.task and rubric to further enhance the more balanced assessment plan		!		
4.incorporate student self-assessment using rubrics		!		
b. develop other types of student assessments to further diversify and balance the course assessment plan; choose from or determine: 1. quizzes 2. projects 3. case studies 4. papers 5. reports 6. literature reviews 7. design problems 8. presentations 9. concept mapping 10. team projects 11. field experiences 12. simulations 13. portfolios		!		
c. employ student self-assessment procedures on particular or all assessments		P N	**Although professors were asked to use a student self-assessment process with the performance tasks/rubrics, only a few actually tried it; others did not. Student self-assessment needs more focus, thought, and process time for professors to more fully implement	**Incorporate student self-assessment as a process; use with performance; consider adding portfolio assessment

Legend:
! Achieved/Excellent
√ Achieved well, or + Moving appropriately towards
P Partially Achieved
N Not Achieved

Outcomes		Status	Notes	Future Changes
VI. To reconsider grades, grading criteria and processes a. no curving of grades b. determine grading criteria c. determine scoring protocols d. implement rubrics e. implement student self-assessment f. determine formal course assessment grading, scoring structure		Completed; Improved √ √ √ ! P N √	See Course Syllabi in Results Reports **Although professors were asked to use a student self-assessment process with the performance tasks/rubrics, only a few actually tried it; others did not. Student self-assessment needs more focus, thought, and process time for professors to more fully implement	No changes; extend by professors as they learn and revise courses
VII. To reconsider other instructional decisions by increasing the repertoire of options: a. choose a broader repertoire of teaching models to use in the redeveloped course b. choose a broader repertoire of teaching styles to use while teaching the redeveloped course c. provide a wider range of learning opportunities that engage a more diverse range of learning styles d. consider multiculturalism and its effect on student learning and planning instruction e. consider student motivational factors in making instructional decisions f. consider student perception factors in making instructional decisions g. consider improvements of learning environment and learning space arrangements (second phase of program)		Completed; Improved √ √ √ √ √ √ N	See Course Analyses, Syllabi, and Results Reports *Some professors had to change learning space to incorporate new performances, but this was not addressed formally in program	As professors keep modifying courses, they will continue to add to each type of repertoire, teaching models, styles, broadened learning styles resulting from additional models and styles
VIII. Determine, design, develop…finalize a. contextual curricula b. learning activities c. group or team learning and assessment processes		Completed; Improved √ √ √	See Course Analyses, Syllabi, and Results Reports; also see Professor Research Reports	Ongoing learning, change, and research

Legend:
! Achieved/Excellent
√ Achieved well, or + Moving appropriately towards
P Partially Achieved
N Not Achieved

Outcomes		Status	Notes	Future Changes
IX. Redesign and develop new course syllabus incorporating the following categories: a. professor, graduate assistant contact information b. catalog course description c. course purpose d. course requirements: text, datebook, curricular course packets, etc. e. course pre- or co-requisites f. expected computer use, knowledge, skills, software, etc. g. student learning outcomes, identifying embedded general education goals, and showing connection to ABET/TAC/NAIT outcomes with links to assessments h. course schedule/timeline showing course weeks/days, topics, activities, due dates, lectures, tests, projects, fieldtrips, etc. i. course requirements: list of assessments and point, percentage, structure, etc. j. grading structure k. academic misconduct or cheating policy l. professor's role; graduate assistant's role m. professor's notes: particular notes about expected behavior, rules, tardiness, absenteeism, cell phones, late assignments, etc. n. support services available to students, (e.g., Writing Center, tutorial services, accessibility services, etc.) o. course references p. course requirements explanation – description of each type of assignment q. course requirements check off – list of all assignments, projects, activities with point, percentage, scoring, or grading information so students can keep track of their progress in course more easily.		Completed; greatly improved √ √ √ √ √ √ √ √ √ √ √ √ √ √ √ √ √ √	Each professor needs to now modify, clean up, and finalize visual format of new syllabi	Perhaps provide graphic template for professors so the final product would reflect: Cleaned up new formats Added missing sections that were recommended by program leaders and literature for inclusion Use of graphics to organize; boxing, etc.

Legend: **!** Achieved/Excellent
√ Achieved well, or **+** Moving appropriately towards
P Partially Achieved
N Not Achieved

Outcomes		Status	Notes	Future Changes
X. Conduct classroom research on teaching and learning a. design research b. select methodology c. conduct experiment d. collect data e. analyze and interpret data f. develop conclusions and recommendations		Completed; excellent √ √ √ √ √ √	Professors engaged in formal, experimental, classroom research. They learned about the complexities of doing experimental research in a social context versus an engineering or technology context. Social science, educational research, is more complex in nature. They produced research manuscripts for publication.	Ongoing learning, change, research, and publications IF sustained initiative in the college.
g. prepare manuscripts for publication Evidence of each professor's Scholarship of Teaching in a research manuscript format; to be submitted to journals.		√ Fine for confirming formal classroom research	Manuscript quality ranged from excellent to appropropite drafts; 2/7 need more consideration, but documented the research fine. All professors need to close the loop by identify future changes and research questions. Some can be submitted to journals in current state; others need revision. But, all provided high quality evidence of the classroom research.	1. Close the Loop 2. Add literature to establish studen basis 3. Add literature to consider results

Table A.2.4: Teaching Portfolio Assessment Chart, January 28, 2007- CITL Faculty Development Program

Portfolio Product (Artifact) Content (See Sections of information following this summary)	RM	RR	*AA	BT	IM	BC	*AG
Self Assessment Baseline: 1.____Student Questionnaires (f05 & f06) 1.____Professor completion(s) of Student Questionnaire (f05 &f06) 2.____Professor completions of Self Competency Questionnaire (Feb.06, May06, Dec.06) **3.**____Program Components Assessments (8) 4.____Standard Departmental Course Evaluations (f05 & f06) 4.____ Student Grades & End of Semester Grades (f05 & f06)	√	√	√	√	√	√	√
5. Course Analysis: 5a1._Course Outline, Embedded Gen Ed, Content Priorities 5a2._Course Content Analysis by TM,TS, LS, Bl, Dale, etc. 5b. _ Instr. Design GAPS Analysis on- TM, TS, LS, B, D 5c. _ Instructional GAPS Summary 5d. _ ABET/TAC/NAIT SLO by Bloom's Analysis 5e. _ Course Content Schedule 5f._ Teaching Models+Cooperative Learning+Study Chart+TM graphic 5g._ Course Calendar by TM, TS, LS, B, D	√	√	√	√	√	√	√
*****Student Learning Styles Inventory:*** (NOT REQUIRED)** Kolb (Extra professional effort on part of professors) Felder (Extra professional effort on part of professor)	K√	K√	NA	NA	NA	F√	NA
Multifaceted Assessment System: 5h.__ Multifacted Assessment Plan Graphic, showing course assessments 5i. __Test and Test Items by SLO Chart 5j.__Assessment Analysis by Bloom (Chart)	√	√	√	√	√	√	√
6. Traditional Objective Tests:: _____Test Analysis (Midterm and Final Exam) _____Table of Specifications (not included) _____Test Item Bank (not included) 7.____New Midterm Exam 7.____New Final Exam 8. ___ Diagnostic Write Ups (MT & F)	√	√	√	√	√- Partial Midterm Analysis X No analysis for Final Exam X Diagnostics No Analysis in Report	√	√
Performance Assessment & Rubrics: 7. _____ 3 Complex Performance Assessments with multiple tasks embedded 7._____3 Rubrics, one to score each Performance Assessment (And to be used with students to establish standards up front) 8._____ Diagnostic Write Ups (PA 1,2,3) *_____ Copies of Students Rubrics (Hardcopies on file) 7._____ Electronic copies of tests and PAs & Rubrics **Other Assessments of Individual Choice: Yes for All**	√	√	√	√	√-Partial Did not seem to use PA 2,3 X	√	√
9. Student Centered Course Syllabus: _____All new components and check off list	√	√	√	√	√	√	√
10. Professors' Research: **____ Completed Data Forms (including data on MT, F, PA1,2,3)** **____ Research Results Reports**	√	√	√	√	Partial √Midterm x No Final- Rubrics √	√	√
12.___Teaching Portfolio Assessment Questionnaire **13___ Teaching Models Self Assessment** **14___ Teaching Styles Self Assessment** **15___ Student Learning Style Opportunities Assessment** **16___ Outcomes Achieved as Planned by Bloom & Dale Assessment**	√	√	√	√	√	√	√
17. Manuscript to be submitted: **_____ Draft** **_____ Final Version to be submitted to journal (May, 2007)**	√	√	√	√	Partial ☺ Final Report, not article	√	√

Legend: √ = okay X = still needed NA= not required See Results in Portfolio Section B.1-12

Scholarship of Teaching
What Counts as Research?

Jule Dee Scarborough, Ph.D. and Jerry Gilmer, Ph.D.

> The richness of faculty talent should be celebrated, not restricted. Only as the distinctness of each professor is affirmed will the potential of scholarship be fully realized. Surely, American higher education is imaginative and creative enough to support and reward not only those scholars uniquely gifted in research but also those who excel in the integration and application of knowledge, as well as those especially adept in the scholarship of teaching. Such a mosaic of talent, if acknowledged, would bring renewed vitality to higher learning and to the nation. (Boyer, 1990, p. 27)

Educational research is certainly distinct from what Wankat, Felder, Smith, and Oreovicz call engineering research (as cited in Huber & Morreale, 2002). Wankat et al. point out that engineering research generally attempts to understand physical mechanisms and phenomena or to identify the effects of specific and unambiguously defined variables on the "behavior of a process or system." Research in the physical world involves clear variables that are measured with what are generally accepted to be unequivocally reliable and valid procedures. On the other hand, social science research, of which educational research is a subset, involves less well defined variables and less reliable and valid measurement procedures. Social science research, however, has a rich history of development and growth that has produced paradigms, procedures, and methodologies very much like those in the physical sciences, which when understood and applied appropriately have led to significant and important findings and advances in social science disciplines, such as education.

Wankat et al. also indicate that the ultimate goal in educational research is to improve learning, but "it is difficult to find two engineering educators who would agree on what that means" (as cited in Huber & Morreale, 2002). Although this is an overstatement, the real issue is that often, due to ambiguities in the meanings of broadly labeled variables like "learning," social science researchers must define the variables they are studying in the context of the current research so readers can consider the researchers' definitions when judging the extent to which they will generalize and apply the results. When the variables, and their measurement procedures, are appropriately and operationally defined by the researcher and when accepted research designs and methodologies are employed, the technical quality of the research is generally not in question. The issue for consumers of educational research, as well as other researchers, is essentially the degree to which the primary researchers' operational definitions of the studied variables conform to the environments and contexts of the consumers and other researchers. This issue is not under the control of the primary researcher. This is very different for engineers and technologists.

One of the most respected sources discussing social science methodologies is *Experimental and Quasi-Experimental Designs for Research* (Campbell & Stanley, 1963). Their booklet "is committed to the experiment as the only means for settling disputes regarding educational practice, as the only way of verifying educational improvements, and as the only way of establishing a cumulative tradition in which improvements can be introduced." Although formal experiments may not be the only way to advance and improve the field of education,

it is clear that Campbell and Stanley are solidly committed to the experimental paradigm as an effective methodology in educational research.

Campbell and Stanley (1963) discuss sixteen different experimental designs, only three of which are classified as *true* experimental designs. The three true experimental designs control for all eight of the potential sources of internal invalidity. The internal validity of an experiment is essentially the extent to which the results of the experiment (i.e., any effects of manipulating the experimental variables) can be generalized and effectively applied by others with some assurance of obtaining the same or at least similar results. Two of the true experimental designs include random assignment of subjects to experimental and control groups and both pre- and post-measurements of the main variable of interest in the experiment (e.g., learning). The third true experimental design includes the random assignment to experimental and control groups but omits the pre-measure. The most common true experimental design is the pretest-posttest control group design.

Experiments that do not involve both experimental and control groups or do not involve random assignment to experimental or control groups are examples of what Campbell and Stanley (1963) refer to as pre-experimental designs and quasi-experimental designs. For example, when an instructor simply changes some pedagogy and then measures students to see if they did better than the previous class, the instructor has employed a pre-experimental design. This design is called the one-shot case study because it lacks a control group. When an instructor uses one teaching strategy in one section of a course, a different strategy in another section of the course, and then compares results from the two sections, the instructor has employed a quasi-experimental design. This design is called the nonequivalent control group design because it lacks random assignment of students to the two sections. Although pre-experimental and quasi-experimental designs can yield useful information regarding effective and non-effective instructional strategies, they do not control for sources of internal invalidity – that is, competing hypotheses remain that can explain the "experimental" results. These are not true experimental designs.

The research designs employed by the professors involved in this project are all true experimental designs. All the designs include experimental and control groups (or at least two distinct experimental groups, each as a control relative to the other) with random assignment and both pretesting and posttesting of the students. The designs are all essentially pretest-posttest control group designs. In some cases, methodological variations were incorporated to fit the needs of the classes and the instructors and to address issues of fairness for the students, such as alternating the experimental intervention between the two groups for balance. The designs remain true experimental designs, and their results should be generalizable to contexts similar to those in these professors' classrooms with similar operationalized variables and similar measurement procedures.

Wankat et al. also suggest that one of the obstacles to the use of true experimental designs in engineering classes is that few classes "have enough students to form experimental and control groups large enough to yield statistically significant results" (as cited in Huber & Morreale, 2002). Although most classes do not have large numbers of students that could yield relatively large experimental and control groups, small classes do not prevent true

experimental research nor do they reduce the validity of the statistical analysis. A class as small as fifteen or twenty students, or even smaller, can probably be randomly split into two groups, and the application of appropriate statistical analysis procedures can result in valid statistical results. The statistical issue between large groups and small groups is that a larger difference between the experimental and control groups is required to achieve statistical significance with small groups than with large groups. The results from large groups may, however, have a better chance of being similar to more contexts in other environments and may thus be more generalizable than the results from very small groups. For this reason, when presenting experimental results, researchers should always provide some descriptive characteristics of their samples to allow consumers and other researchers to judge the similarity of the sample to their own environments.

Classroom Assessment and Research: An Update on Uses, Approaches, and Research Findings (1998) connects classroom assessment, classroom research, and the Scholarship of Teaching (Boyer, 1990). Each chapter illuminates the importance of research on teaching and learning if we are, in fact, going to improve teaching and learning. The chapters in this book cover classroom assessment techniques and cognitive learning theory, as well as approaches, strategies, and specific tools for both research and assessment in classrooms. One chapter focuses on TQM, while others are on cases, performance through student teams, etc. This volume and its collection of articles are a great resource for deepening understanding of the Scholarship of Teaching through classroom research and assessment, but especially for understanding the difference and interdependent relationship between the research and student assessment. Cross discusses the shift from assessment for accountability to assessment for improvement, clearly the goal in research on teaching and learning (as cited in Angelo, 1998). Cross advocates for involving students in the assessment process because students can inform professors about how effectively they are learning rather than getting feedback too late, e.g. after a test. He suggests using a strategy that produces a stream of continual feedback on how well learning is occurring. The minute paper discussed elsewhere is one simple, yet engaging, method. Where classroom research and assessment have been used interchangeably, Cross makes the distinction between the two. Classroom assessment addresses the “what” questions of teaching and student learning: what is going on, what did students learn from the lesson, what did they not understand, and what do they have questions about. However, classroom research addresses understanding the “why” and “how” questions regarding learning. Why did students respond in a particular way? Why do they not understand the content? Why are they having difficulty? Classroom research leads us to understand how students learn and encourages us to use our classrooms as laboratories to study teaching and learning.

However, very few professors or college instructors know much about learning or its process. Cross goes on to specify a difference between traditional research and classroom research (as cited in Angelo, 1998). Classroom research is not an add-on activity. It must be embedded in the ongoing work of teaching and student learning – the work of the class. It is unlike research in the disciplines because it does not require special equipment and easy access to research libraries or colleagues engaged in cutting edge research. Professors and instructors have all they need to do first-rate research right in their classrooms. Research in the classroom should involve students as collaborators rather than as subjects. This pays off as

they are eager to participate and learn a great deal about their own learning while simultaneously learning the academic skills of inquiry and analysis. Very important to note is that classroom research differs from traditional research in that it completes the cycle of asking the question and then making changes in teaching practices based upon the outcome(s) of the research.

The long held traditional research practice has been for researchers to engage in a research project, write up the findings, and then publish the results with recommendations for further research, often not using the results themselves. This is a most ineffective design if one's goal is to improve teaching and learning. Teachers are too busy to read research reports, especially those with equivocal findings that may or may not apply to their situations. Professors engaging in their own classroom research find the results much more relevant and useful, while still contributing to the body of research knowledge on teaching and learning. Classroom research conducted in his/her own classroom focuses on questions that the professor finds meaningful and relevant, and the results can be used immediately. Professors can engage in using what they learn diagnostically to improve teaching and learning. They can go further to engage students in "diagnostic learning logs," where students analyze their own learning prompted by several questions. I have used this approach both on its own throughout classes and then also as a method tied to student portfolio development. Also in classroom research an "N of one" may be more valuable than an "N of hundreds" to assure statistical significance in more traditional correlational research. Although more qualitative in nature, interviews, logs, and other methods can tell a professor much more than statistics. However, as mentioned above, we are trying to use good quantitative methods and procedures as well as good qualitative methods and procedures, as the use of both often reveals more. The best research scenario is when professors engage in research on teaching and learning, use that research diagnostically to improve teaching and learning, and follow through with publishing their results so they inform others and add to the collective larger body of knowledge.

Cross also makes another important point, that of solitary versus community engagement (as cited in Angelo, 1998). Whereas research has often been solitary, especially in engineering (isolated splendor), Cross notes that once faculty begin to engage in classroom research, they become eager to share it with colleagues. This should be supported formally by the administration, as classroom research can become isolated as well if there is no easy mechanism for sharing in a community environment. This, to me, is as important as publishing to the larger external community. Research questions and research methods can benefit from a community process where professors discuss, question, interpret, draw conclusions, and seek to design further research. Thus, classroom research is a great stimulus for the creation of a faculty learning community about teaching and student learning. She advocates for Boyer's (1990) position that college teaching is a scholarly profession that is coming into its own. She further notes that while the members of a profession, engineering and technology in our case, are bound together by sharing their knowledge and expertise and by making judgments about the practice of their profession, "strangely missing from the profession of teaching of teaching …is the ability to advance the profession through a shared base of knowledge about human learning. Classroom research has the potential for

understanding learning well enough to improve it – as individual classroom teachers and collective faculties dedicated to the mission of improving undergraduate education" (p. 12).

Another good resource to provide knowledge, understanding, and tools for designing, executing, and analyzing classroom research is *Classroom Research – Implementing the Scholarship of Teaching* (Cross & Steadman, 1996). Although there are many others, these two resources, and more if one chooses to simply search them out, provide a good foundation for someone interested in the "grand experiment" of good teaching through the Scholarship of Teaching. Others that resonate for our initiative are

- *The Scholarship of Teaching and Learning: A National Initiative* (Cambridge, 2000) discusses the Pew Scholars Fellowship, the Campus Program, and the Work with Scholarly Societies that seek to support Boyer's (1990) call for action.
- *Advancing the Scholarship of Teaching Through Collaborative Self-Study* (Louie et al., 2003) describes faculty group work engaged in self-study to advance scholarly inquiry in which professors examine their beliefs and actions as educators, "allowing professors to renew their instructional tools as well as discover new tools to convey the rich and changing knowledge in a discipline." Self study, compared to participation in traditional workshops, brings about many more benefits (e.g., focused learning, real contextual focus on their students and classrooms, controlled purpose and outcomes, tangible and relative products, and more). They go further to advocate self-study research in which university faculty members build upon existing research expertise to improve their teaching. As our work is truly collaborative self-study, we agree with these authors and find their model involving assessment, implementation, and dissemination affirming. They conclude, as we have, that "collaborative self-study research holds significant potential for creating valid, useful pedagogical content knowledge as well as for improving teaching practice." (p.151; p.164)
- *Teaching as an Act of Scholarship* (Nkomo, 1996) expresses reflections about the connection between teaching and research in response to Nord's (1996) essay.
- *Research/Teaching Boundaries* (Nord, 1996) reflects on the relationship between teaching and research.

Action Research – Is it Different and Does It Count?

Let us consider another hot topic in today's educational research arena – action research. What is the difference between the Scholarship of Teaching as described by Boyer (1990), the quality of research that we are striving for in this initiative (true experimental research with control groups, etc.), and action research. Action research has been regarded "suspiciously" by some and has not been acknowledged as worthy research methodology. However, although not always form, not usually designed with control groups, or experimental in nature, it can be quite beneficial. Here are some definitions:

> Action research entails studying your own situation to change the quality of processes and results within it. To do action research is to empower yourself to study your actions so that your future actions will be more effective. It also aims to improve your professional judgments and to give you insight into how better to achieve your educational goals. Through action research, you can convert current practices into better procedures, better instructional strategies, and better curriculum. [It] is a

> continuous and cyclical professional activity that is integrated into your regular practice. (Schmuck, 2006, p.28)

This certainly reflects the discussion by Louie et al. (2003) mentioned above.

As an alternative to traditional research, action research is practical, participative, empowering, interpretive, tentative, and critical. This means that a professor can gain insights from data that lead to practical changes, and that a professor and his/her students and/or colleagues can work together to collect data about real issues rather than some outside, disinterested party performing the study. Engaging together creates equal participants where together a group can pool its perceptions, attitudes, and interpretations about the inquiry. There are no right or wrong answers but instead a creation of awareness of new possibilities and directions to try in the classroom, and finally, there is critical reflection in which as the group as "self-critical change agents" explores results, feedback, and considers them in light of change (Schmuck, 2006, p. 29).

Two models to consider are *proactive* and *responsive* action research. Critical reflection (Reflective Practice) might lead one to try a new practice in which one wanted to better connect values with practice. Steps in this *proactive* action research process are

1. List hopes and concerns for the new practice.
2. Perform a knowledge search and then try the new practice for more effectiveness and better outcomes.
3. Search for the best research procedures; collect data to track student reactions and behavioral changes.
4. Analyze the data.
5. Reflect on alternative ways to behave.
6. Fine-tune the new practice…or try a different new practice. (Schmuck, 2006, p.32)

With *responsive* action research, diagnostic data is collected before trying a new practice; therefore, one engaging in the responsive process would

1. After searching for appropriate methods, collect data to diagnose the situation.
2. Analyze the data for patterns, themes, or ideas for action or practice.
3. Perform a knowledge search, distribute the data, and announce the changes that will be made [to the students].
4. List [for them] what is desired – the hopes or concerns for the new practice.
5. Try the new practice for more effectiveness and better outcomes.
6. Collect data and evaluate the new practice.

The phases of action research could be considered *Initiation*, *Detection*, and *Judgment.* Schmuck (2006) provides designs, methods, tools, and good discussion about action research. It differs in that a researcher will not use true experimental designs; action research comes closer to Campbell and Stanley's (1963) pre-experimental or quasi-experimental designs, where there are no control groups or random assignment of students into groups for comparison.

For example, when an instructor simply changes some pedagogy and then measures students to see if they did better than the previous class, the instructor has employed a pre-experimental design; this design is called the one-shot case study because it lacks a control group. When an instructor uses one teaching strategy in one section of a course and a different strategy in another section of the course and then compares results from the two sections, the instructor has employed a quasi-experimental design; this design is called the nonequivalent control group design because it lacks random assignment of students to the two sections. Although pre-experimental and quasi-experimental designs can yield useful information regarding effective and non-effective instructional strategies, they do not control for sources of internal invalidity – that is, there remain competing hypotheses that can explain the "experimental" results. These are not true experimental designs.

However, do not underestimate the relevance, significance, or value of Action Research, even with its constraints or limitations. When well researched, thought out and formulated, and where appropriate consideration is given to the design and execution of the research, where the new practice or strategy is well defined and described, and especially where the student assessments have high integrity, action research, to me, is one type of research that is valuable and should be considered an accompanying option in the Scholarship of Teaching. In my humble opinion, there should be a mix, ongoing action research combined with formal true experimental and quasi-experimental research.

The Scholarship of Teaching, whether in its highest form (experimental), very strong forms (pre-experimental and quasi-experimental), or somewhat more informal or less controlled form (action research), all have the same goal – improving teaching for higher or increased student learning; therefore, each deserves its respective place in a professor's research repertoire and acknowledgment of its potential to contribute to the goal of adding knowledge to the fields of teaching and student learning. A few other good resources on action research are

Action Research –Teachers as Researchers in the Classroom (2006)
Macintyre. (2000). *The Art of Action Research in the Classroom*
McNiff & Whitehead. (2002). *Action Research*
Mills. (2000). *Action Research*
Noffke & Stevenson. (1995). *Educational Action Research*
Somekh. (2006). *Action Research* – a methodology for change and development
Zuber-Skerritt. (1992). *Action Research in Higher Education*

Program and Classroom Research Designs

As mentioned in the faculty development program section, this project consists of faculty development in preparation for classroom research, qualified by Boyer (1990) as the Scholarship of Teaching. The participating professors are from the College of Engineering and Engineering Technology (CEET) at Northern Illinois University. The professors were selected for participation in the program by the college administration. The faculty development program included traditional and performance-based faculty development in the areas of reflective practice - course and teaching analysis; course development, testing, and performance assessment/rubric analysis and development; teaching and learning strategies;

and research design, methods, and procedures. Participants were assessed traditionally and through performances. The professors participated in the development activities during the spring of 2006. (See the Faculty Development Program section of this document – A.5).

The research component of the program includes experimental studies by the professors in their own classrooms that are intended to provide the professors with authentic, real world, educational research experiences. The experimental conditions of these studies involved the application of different models, strategies, and procedures learned about during the faculty development program Spring 2006. For example, some professors examined the effects of traditional versus performance assessment in their classrooms, while other professors examined the effects of different teaching methods – passive versus active learning and different levels of cooperative learning techniques.

All the professors received training on all faculty development program components in Spring 2006; however, the individual classroom implementation and research varied across professors. The following designs explain their choices in teaching strategies/models and/or student assessment procedures. Because all professors implemented changes in their courses and syllabus as a result of their analyses and because they all developed new traditional tests and new performance assessments, these components were implemented by all participating professors during the 2006 research semester. However, because of the integral nature of each of these components relative to each other, the effectiveness of these components will be assessed as a single unit. That is, the effectiveness of course and teaching analyses will not be isolated from the effectiveness of classroom testing and assessment, except where professors have chosen to research the use of traditional tests versus performance assessments. For a brief and broad review, see the Faculty Development Program Section A.5:

Program Component 1: Reflective Practice – Course and Teaching Analyses
Program Component 2: Student Assessment – Traditional Tests
Program Component 3: Performance Assessment – Performance Tasks and Rubrics
Program Component 4: Teaching Strategies, Models, Methods, Techniques
Program Component 5: Classroom Research

The effectiveness of the overall Faculty Development Program was evaluated through examination of several assessment variables. The variables are briefly described below. Also included with these descriptions are statements indicating which program components are evaluated by each variable. The relationships between the program components and the assessment variables are also presented in Table 1.

1. <u>Self Perceptions of Competency</u>**:** The professors were asked to complete a questionnaire soliciting their perceptions of their competency levels with respect to different aspects of the faculty development program. Indices of competency scores were developed and analyzed statistically. The assessment of the professors' perceptions of competency addressed the overall effectiveness of the faculty development program.

2. Content Knowledge of Specific Components. Component-specific content knowledge was assessed through a questionnaire or quiz administered before the delivery of each program component and at two different times after the component development. The assessment of the professors' content knowledge for each component addressed the effectiveness of the content development for each separate component.
3. Value/Usefulness of Specific Components. Brief evaluations of each component were obtained after the development activities for each program component. Questions such as "Was the information useful?" and "Would you recommend that other faculty learn the material?" were asked. These evaluations addressed the value and usefulness of each separate component.
4. End of Course Evaluations – A) NIU (current) B) Project (new). In addition to the current standard course evaluations that students provide for each class, a separate end-of-course evaluation instrument was developed to assess specific aspects covered in the faculty development program. The evaluations, administered in the professors' classes both before and after the delivery of the faculty development program examined whether the professors were successful in implementing the content of the program in their classrooms – based on students' perceptions.
5. Test Analysis. One method for improving an existing test is to perform a test analysis. The quantitative procedures of test analysis will result in the identification of specific items that do not "perform" as expected by the instructor: for example, an item may be too difficult, or perhaps some of the more proficient students answer an item incorrectly, while less proficient students answer it correctly. To assess the degree to which the modified test has actually been improved, the proportion of poorly performing items from the modified posttest (e.g., the Fall 2006 final) will be compared to the proportion of poorly performing items from the original pretest (e.g., the Fall 2005 final).
6. Performance Assessments. Although no performance assessments were administered for Fall 2005, all professors developed three complex performance tasks with corresponding rubrics. These were administered by each professor for Fall 2006. The results of using performance assessment as an additional type of student learning assessment will be judged qualitatively from professor self-reports about their reactions to performance assessment as well as any information stemming from student reactions.
7. Course Grades. Due to the number and variety of factors that can affect course grades, confounding year-to-year comparisons, no analyses involving grades were performed. It is suggested here, as well as with course grades, that professors include course grades as a factor in the research design.

8. Portfolios. The professors built formal teaching portfolios that provide full evidence of their new knowledge and skills on teaching and learning. These provided the opportunity to judge the quality of their analyses, level of learning, and educational products to be used in the classroom.
9. Research. The professors have engaged only in engineering-related research up until now; there had been no educational research. Student learning data were collected and analyzed. Research results were reviewed in manuscripts prepared by each professor for publication during Spring 2007.

Table A.3.1 presents the relationships between the five program components and the seven assessment variables.

Table A.3.1: Assessment Variables Used to Evaluate Different Training Program Components

	Faculty Development Program Components				
Assessment Variables	1. Analysis	2. Testing	3. Performance	4. Methods	5. Research
1. Self Perceptions of Competency	To evaluate the overall training program				
2. Content Knowledge of Specific Components	Component 1 Assessment	Component 2 Assessment	Component 3 Assessment	Component 4 Assessment	Component 5 Assessment
3. Program Feedback and Evaluation	Component 1 Assessment	Component 2 Assessment	Component 3 Assessment	Component 4 Assessment	Component 5 Assessment
4. End of Course Evaluations: A) NIU(current) B) Project(new)	To evaluate components 1 – 4, overall				
5. Test Analysis	To evaluate the combination of components 1 & 2				
6. Performance Assessments	To evaluate components 1, 2, & 3				
7. Course Grades	Due to the number and variety of factors that can affect course grades, confounding year-to-year comparisons, no analyses involving grades was performed.				
*8. Professors' Portfolios	To evaluate the overall faculty development program				
*9. Professors' Research	To evaluate the overall faculty development program				

The complete matrix of data sources, times for pre- and post- data collection, and the specific statistical analysis for each of the seven assessment variables are presented in Table A.3.2.

Table A.3.2: Data Sources, Measurement Times, and Analysis Procedures for Each of the Assessment Variables

Assessment Variables	Data Source	Pre Measures	Post 1 Measures	Post 2 Measures	Analysis
1. Self Perceptions of Competency	Professors	At Program Orientation	After Overall Training	End of Fall 2006 Courses	Dependent Groups t-tests
2. Content Knowledge of Specific Components	Professors	Prior to Component Training	After Each Component is Presented	End of Fall 2006 Courses	Dependent Groups t-tests
3. Program Feedback and Evaluation	Professors		After Each Component is Presented		Qualitative
4. End of Course Evaluations: A)NIU (current) B)Project (new)	Students in Professors' Classes	End of Fall 2005 Courses	End of Fall 2006 Courses		Independent Groups t-tests
5. Test Analysis	Students in Professors' Classes	Fall 2005 Courses	Fall 2006 Courses		Independent Groups t-tests
6. Performance Assessments	Students in Professors' Classes		Fall 2006 Courses		Qualitative / Correlations
7. Course Grades	Due to the number and variety of factors that can affect course grades, confounding year-to-year comparisons, no analyses involving grades was performed.				
8. Professors' Portfolios	Professors		After Overall Program Completion		Qualitative
9. Professors' Research	Professors		Spring 2007 and Beyond		Qualitative

The first post measurement for variable 1 will occur shortly after the delivery of the entire training program; for variables 2 and 3, the first post measure occurs after the delivery of each

separate component. This first post measurement will address the immediate effectiveness of the program delivery and the value and usefulness of the content. The second measurement of variables 1 and 2 at the end of the Fall 2006 courses will address the stability (the retention) of the knowledge gained during the program delivery phase and after the implementation and reinforcement of that knowledge during the Fall 2006 term.

The data sources for variables 4 – 7 are the students in the professors' classes for Fall 2005 (pre) and Fall 2006 (post). Because these are distinct (independent) groups, it is appropriate to analyze the data through independent group t-tests, except where qualitative analyses are indicated.

* The assessment variables 8 and 9 will be reviewed and judged qualitatively as to their effect on the overall faculty development program. Quantitative student learning data will be collected during assessment of variable 9. Although student gain <u>could</u> be considered an evaluative measure of the overall faculty development program, a second measure is also inherent in that variable: professors performing formal research on teaching and learning. Therefore, there will be a more qualitative approach to this analysis.

The specific research studies to be performed by the professors are discussed below.

Regina Rahn – Primary Study

Model 1 –Traditional Test with Performance Assessment

This study is designed to examine the following questions:

1. Does the administration of a performance assessment that covers a subset of content also covered in a traditional midterm result in increased learning beyond the administration of the traditional midterm alone as indicated by the scores on the traditional midterm?
2. Does the administration of a performance assessment that covers a subset of content also covered in a traditional midterm result in increased knowledge retention beyond the administration of the traditional midterm alone as indicated by a separate final exam?

The basic design for this study is presented in the table below.

Table A.3.3: Model 1

Model 1: Traditional Test With Performance Assessment

		Treatment	Posttest 1		Posttest 2
Experimental Group	Instruction	Performance Assessment Related to Traditional Test	Traditional Midterm	----------→	Traditional Final
Control Group	Instruction	Performance Assessment <u>Not</u> Related to Traditional Test (Placebo)	Traditional Midterm	----------→	Traditional Final

Students will be randomly assigned to the experimental and control groups, and therefore, those groups can be considered equivalent. The treatment for the experimental group is essentially the administration of the traditional midterm along with some performance assessment activities covering some of the same content that is covered in the traditional midterm. The treatment for the control group is the administration of the traditional midterm and a placebo – perhaps some performance assessment activities that are not related to the content in the traditional midterm. After the administration of the Traditional Test (Posttest 1), the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

- Question 1 will be addressed by comparing the traditional midterm means across the experimental and control groups.
- Question 2 will be addressed by comparing the final exam means across the experimental and control groups (for the content in the final that is also in the midterm) across the two groups.

Regina Rahn -- Secondary

Model 4 – Individual Learning versus Cooperative Learning

This study is designed to examine the following questions:

1. Does individual learning versus cooperative learning result in differential knowledge gains as indicated by a traditional cognitive test?
2. Does individual learning versus cooperative learning result in differential knowledge retention as indicated by a final exam?

The design for this study is presented in the table below.

Table A.3.4: Model 4

Model 4: Individual Learning vs. Cooperative Learning				
	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Traditional Test	----------→	Final
Cooperative Learning Group	Cooperative Learning	Traditional Test	----------→	Final

Treatment				
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Individual	Cooperative	Individual	Cooperative
2	Cooperative	Individual	Cooperative	Individual

Random assignment of students to two groups will allow us to assume the groups are equivalent. The actual delivery of the treatment conditions will alternate across content areas and groups, as shown in the blowout diagram. Group 1 will be the individual learning group for content areas I and III, while group 2 will be the individual learning group for content areas II and IV. This will add to the validity of the design and enhance the fairness of the treatment conditions within the student groups. For this delivery model to work, there needs to be an even number of content areas with a minimum of two. For fairness to students, each content area should also be weighted approximately equally within both posttests. After the administration of the Traditional Test (Posttest 1), the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

- Question 1 will be addressed by comparing the posttest 1 means under the individual and cooperative learning conditions.
- Question 2 will be addressed with similar comparisons on the posttest 2 means.

Model 2 – Performance Assessment and Traditional Test Administered in Different Order

This study is designed to examine the following questions:

1. Does a performance assessment administered in conjunction with a traditional test result in increased learning beyond the traditional test alone as indicated by scores on the traditional test?
2. Does the order of the administration of a performance assessment and a traditional test result in differential learning as indicated by the combination of the performance assessment and traditional test scores?
3. Does the order of administration of a performance assessment and a traditional test affect knowledge retention as indicated by a final exam?

The basic design for this study is presented in the table below.

Table A.3.5: Model 2

Model 2: Performance Assessment and Traditional Test Administered in Different Order

Group 1	Instruction	Performance Assessment	Traditional Test	----------→	Final
Group 2	Instruction	Traditional Test	Performance Assessment	----------→	Final

Students will be randomly assigned to the experimental and control groups, and therefore, those groups can be considered equivalent. Group 1 will receive the performance assessment before the traditional test, and group 2 will receive the traditional test before the performance assessment.

- Question 1 will be addressed by comparing the traditional test means between the two groups.
- Question 2 will be addressed by comparing the combined performance assessment and traditional test scores between the two groups.
- Question 3 will be addressed by comparing scores from the final that are based on material also covered on the midterm (the performance assessment and the traditional midterm test) between the two groups.

Abhijit Gupta

Model 2 – Performance Assessment and Traditional Test Administered in Different Order

This study is designed to examine the following questions:

1. Does a performance assessment administered in conjunction with a traditional test result in increased learning beyond the traditional test alone as indicated by scores on the traditional test?
2. Does the order of the administration of a performance assessment and a traditional test result in differential learning as indicated by the combination of the performance assessment and traditional test scores?
3. Does the order of administration of a performance assessment and a traditional test affect knowledge retention as indicated by a final exam?

The basic design for this study is presented in the table below.

Table A.3.6: Model 2

Model 2: Performance Assessment and Traditional Assessment Administered in Different Order

Group 1	Instruction	Performance Assessment	Traditional Test	----------→	Final
Group 2	Instruction	Traditional Test	Performance Assessment	----------→	Final

Students will be randomly assigned to the experimental and control groups, and therefore, those groups can be considered equivalent. Group 1 will receive the Performance assessment before the traditional test, and group 2 will receive the traditional test before the Performance assessment.

- Question 1 will be addressed by comparing the traditional test means between the two groups.
- Question 2 will be addressed by comparing the combined performance assessment and traditional test scores between the two groups.
- Question 3 will be addressed by comparing scores from the final that are based on material also covered on the midterm (the performance assessment and the traditional midterm test) between the two groups.

Reinaldo Moraga

<u>Model 4 – Individual Learning versus Cooperative Learning</u>

This study is designed to examine the following questions:

1. Does individual learning versus cooperative learning result in differential knowledge gains as indicated by a traditional test?
2. Does individual learning versus cooperative learning result in differential knowledge retention as indicated by a final exam?

The design for this study is presented in the table below.

Table A.3.7: Model 4

Model 4: Individual Learning vs. Cooperative Learning

	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Traditional Test	----------→	Final
Cooperative Learning Group	Cooperative Learning	Traditional Test	----------→	Final

Treatment				
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Individual	Cooperative	Individual	Cooperative
2	Cooperative	Individual	Cooperative	Individual

Random assignment of students to two groups will allow us to assume the groups are equivalent. The actual delivery of the treatment conditions will alternate across content areas and groups, as shown in the blowout diagram. Group 1 will be the individual learning group for content areas I and III, while group 2 will be the individual learning group for content areas II and IV. This will add to the validity of the design and enhance the fairness of the treatment conditions within the student groups. For this delivery model to work, there needs to be an even number of content areas with a minimum of two. For fairness to students, each content area should also be weighted approximately equally within both posttests. After the administration of the Traditional Test (Posttest 1), the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

- Question 1 will be addressed by comparing the posttest 1 means under the individual and cooperative learning conditions.
- Question 2 will be addressed with similar comparisons on the posttest 2 means.

Robert Tatara

Model 4 – Individual Learning versus Cooperative Learning

This study is designed to examine the following questions:

1. Does individual learning versus cooperative learning result in differential knowledge gains as indicated by a traditional test?
2. Does individual learning versus cooperative learning result in differential knowledge retention as indicated by a final exam?

The design for this study is presented in the table below.

Table A.3.8: Model 4

Model 4: Individual Learning vs. Cooperative Learning

	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Traditional Test	----------→	Final
Cooperative Learning Group	Cooperative Learning	Traditional Test	----------→	Final

	Treatment			
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Individual	Cooperative	Individual	Cooperative
2	Cooperative	Individual	Cooperative	Individual

Random assignment of students to two groups will allow us to assume the groups are equivalent. The actual delivery of the treatment conditions will alternate across content areas and groups, as shown in the blowout diagram. Group 1 will be the individual learning group for content areas I and III, while group 2 will be the individual learning group for content areas II and IV. This will add to the validity of the design and enhance the fairness of the treatment conditions within the student groups. For this delivery model to work, there needs to be an even number of content areas with a minimum of two. For fairness to students, each content area should also be weighted approximately equally within both posttests. After the administration of the Traditional Test (Posttest 1), the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

- Question 1 will be addressed by comparing the posttest 1 means under the individual and cooperative learning conditions.
- Question 2 will be addressed with similar comparisons on the posttest 2 means.

Ibrahim Abdel-Motaleb

Custom Model: Individual Performance-Based Learning versus Cooperative Performance-Based Learning

The basic research question in this model is

1. Does individual performance-based learning or cooperative performance-based learning result in better student learning as reflected in an end-of-unit exam (either midterm or final).

Table A.3.9: Research Model

Research Model: Individual vs. Cooperative Performance-Based Learning						
		Treatment	Posttest		Treatment	Posttest
Experimental Group 1	Instruction	Individual Performance-Based	Midterm	Instruction	Cooperative Performance-Based	Final
Experimental Group 2	Instruction	Cooperative Performance-Based	Midterm	Instruction	Individual Performance-Based	Final
	Replication 1			Replication 2		

Students will be randomly assigned to the two experimental groups, and therefore, those groups can be considered equivalent. The experiment will actually be administered twice during the semester. To enhance the fairness to the class, both groups will be exposed to both treatment conditions – alternating across the two replications. The final is not a comprehensive final, so there should be no carryover from the midterm to the final that might contaminate the interpretation of the results.

The research question will be addressed by comparing the mean test scores between the two groups for each replication of the experiment.

Brianno Coller

Model 1: Hands-On Manipulative Procedures versus Graphical Procedures

This study is designed to examine two questions:

1. In problem-based-learning projects, are hands-on manipulative procedures more effective on learning than graphical procedures, as reflected in a midterm exam?
2. In problem-based-learning projects, are hands-on manipulative procedures more effective on retention of learning than graphical procedures, as reflected in a final exam?

Figure A.3.10: Model 1

Model 1: Hands-On Manipulative vs. Graphical					
		Treatment	Posttest 1		Posttest 2
Experimental Group 1	Instruction	Hands-On Manipulative	Midterm	----------→	Final
Experimental Group 2	Instruction	Graphical	Midterm	----------→	Final

Students will be randomly assigned to the two experimental groups, and therefore, those groups can be considered equivalent. Each group will be given some problem-based learning tasks. Group 1 will attempt to resolve/complete the tasks with hands-on manipulation of physical objects, while group 2 will attempt to resolve/complete the problems with graphical techniques. After the administration of the midterm (posttest 1), the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

- Question 1 will be addressed by comparing the posttest 1 means between the two groups.
- Question 2 will be addressed by comparing the posttest 2 means between the groups and by comparing the posttest 1 means to the posttest 2 means (for the items in the final that cover material in the midterm) across the two groups.

Results and Conclusions

Results

The research results can be reviewed from two perspectives: the program and classroom research.

Regarding the faculty development program:

The faculty development program was very successful across all its components. The participating faculty member feedback was excellent, and their educational products were all developed to quality expectations. In fact, considering that this was the first time faculty members had analyzed their courses formally (and to such high standards); the first time that they had considered teaching practices, or engaged in intense critical reflection, about teaching models, styles, learning styles, Bloom's Taxonomy, and/or Dale's Cone; the first time they developed tests and performance tasks/rubrics to particular specifications and with some knowledge about what good tests and performance tasks/rubrics are; and more, their knowledge and skill gain and their educational products were outstanding.

Regarding specific program assessment variables

There was significant gain on the part of all faculty members in their self perceptions of competency as well as the content knowledge of program components. Faculty members consistently assigned a very high value to the usefulness of the program components through the feedback process. They performed well according to their performance on test analysis procedures and the development of their new objective tests. Also they produced well developed performance tasks and rubrics and followed through with formal and experimental classroom research during their redeveloped courses, using their new educational products, instructional models, styles, strategies, new tests, new performance tasks and rubrics as well as selected teaching models, styles. Three used Kolb or Felder learning style inventories, and they all produced research manuscripts. Finally, each professor has a teaching portfolio reflecting their gain, growth, analysis and change process, and educational products.

Faculty members suggested shortening the program for sustainability; however, they also requested more depth on cooperative learning, the addition of programming on student teaming, as well as classroom management and student conflict resolution or management. Finally, there would be a great need to provide additional learning opportunities about educational research, methods and procedures. And faculty members need to continue to deepen their understanding of learning theory and teaching methods.

Regarding the classroom research

Each faculty engaged in formal experimental classroom research. Therefore, this program aspect was very successful. The research designs resulted from the faculty members working with the program leaders to determine their interests in their first attempt at educational research with students in the classroom. Once their theoretical interests were determined, a design was generated and appropriate methodology and procedures were determined. (Understand that this was the primary goal, the design and execution of formal educational research in the classroom.) Although the results of the research were viewed as very important, that was truly secondary for us, as we wanted to bring the faculty members into

the educational research arena by preparing them as well as could be expected on theory and best practices in just 18 days. Of course, we understand that a deep understanding of theory and practice cannot result from 18 days, regardless of how dedicated the learners are. However, they learned a lot and are interested in learning more and deepening their understanding about the theory. Therefore, the goal of engaging in research was our first priority goal. Professors were committed to their classroom research and were serious about their research focus. However, regarding student learning for each individual study, there was no significant learning gain across the studies. Of course, that is not "failure" for us, although if not careful, faculty members engaging in educational research for the first time could perceive it that way. Most important is that they explain their results. Thus, each professor produced a research manuscript describing his/her research, design, methodology, procedures, results and conclusions.

What is important to discuss are the following variables

Standard End of Course Evaluations
Although not a realistic expectation, we had hoped that students in the redeveloped 2006 course would evaluate the course more positively than students in the 2005 courses. In using the regular, standard course evaluation forms (used each semester), there was no significant difference between the two evaluations. Recall that the professors invited to participate varied in their standard teaching evaluation scores. And although some scores shifted somewhat, these shifts could be normal shifts and were not significant enough to reflect differences that could be attributed to the treatment variables. This research aspect needs to be considered and designed into a study more formally; also it needs to be tracked across many semesters and studied longitudinally.

New End of Course Questionnaires
This questionnaire was developed for several purposes. Its content focused comprehensively on the content within the faculty development program components (e.g., teaching models and styles, student learning styles, course quality, syllabus, assessment, and more). It was developed to reflect the whole program. Therefore, it was a "bank" of all possible questions one could ask students about the course to see if students noted changes during their course experience regarding the new strategies, models, styles, products, behavior, and more that professors learned about in the faculty development program and may be trying or improving. The questionnaire was administered to the 2005 class as a baseline and then again to the 2006 class, different students. Professors were provided a script and instructions for administration of the questionnaire. We acknowledge that because of the comprehensiveness of the questionnaire, it was too long to be used generally, but we had to begin somewhere. However, there was a significant positive change between the 2005 administration of the questionnaire and the 2006 administration of the questionnaire.

The participating professors were also asked to complete this form in 2005 and 2006 from the perspective of how they felt the students might feel about their courses, instruction, etc. The same individual scanning the student questionnaires also scanned the professors' questionnaires for both 2005 and 2006. He made a less intense, but similar comment about

the 2006 faculty administration of the questionnaire, but not about the 2005 administration. That led us to consider some questions about the use of the questionnaires. Therefore, we met with the professors and discussed the questionnaires.

1. Was the administration of the questionnaire to students any different in 2005 than it was in 2006?
   Response: No really any difference.

2. Do you think the students in those classes took the questionnaire seriously?
   Response: Yes, we think they did.
3. Did the students have less time in 2006 to complete the questionnaire?
   Response: Not really.

4. Did you complete both the 2005 and 2006 questionnaire equally seriously?
   Response: Yes

5. Do you feel that the responses of the student in 2006 should be considered suspiciously?
   Response: No, we feel the results valuable.

6. Do you feel the results are valid and that you can use them?
   Response: Yes.

The professors did not really agree with the individual who scanned the forms. Their perspective is acknowledged as different. They felt inclined to use the results and that the results informed and benefited them. So we noted this in the data report section. However, in further discussing that questionnaire, it is a very good bank of questions. However, we would suggest that as the professors' research becomes focused on particular aspects, they could choose specific questions to use in their baseline and later administration of the questionnaire. This would also result in a shorter questionnaire and take less time and concentration for students. If we had known what the professors were going to focus on during the research semester, we could have done that with the 2005 and 2006 classes. However, since the professors had not begun the faculty development program at the time of collecting the baseline data that was not possible, so we decided to administer the entire questionnaire, fully understanding the issue of length and time.

Course Grades

We did not ultimately use the 2005-2006 course grades as a variable. We did not formally build it into the research and evaluation with specific research questions. Therefore, we could attribute any course grade shifts as attributed to treatment variables. Finally, we and the professors were interested in measuring student learning for the entire course, but we did not build pre- and post-course assessment of learning into their studies. We have suggested that they can easily add that measure to their studies, either replications or new studies, and encouraged them to do so.

Conclusions
The faculty development program was successful in content and process. The classroom research was also successful.

Recommendations

1. Shorten the faculty development for sustainability.
2. Use the student questionnaire as a bank of questions from which to choose, selecting items that match the research focus
3. Add some program components (e.g., student teaming, classroom management and student conflict resolution or management)
4. Add more program and time on cooperative learning and educational research
5. Continue learning opportunities to extend knowledge on learning theory and instructional practices
6. Continue the formal LC

TODAY'S STUDENTS

Jule Dee Scarborough, Ph.D.

When considering student demographics, we present the traditional statistical backgrounds, educational interests, gender, ethnicity, and other descriptors of today's students (Brown, 2003; Kuh, 2003; Lovett, 2003). Additionally, we discuss student demographics from other perspectives that are more subjective. Central to our concerns – Engineering (and Technology), we include the U.S. Department/National Science Foundation's (1998) study on Women and Men of the Engineering Path, Light and Cox's (2001) findings from 1600 student interviews regarding their preferences about education, and Howe and Strauss's (2000) in-depth discussion of the Millennials. Levine and Cureton (1998) consider the Generation Xers in comparison to Levine's (1980) previous study of the Boomers. These studies focus more on attitudes, feelings, insights, life experiences, difficulties, and demands. To us, these are the more significant demographics if we are to know our students: what they are about, what their lives are demanding of them, etc. In addition, we will present Brown's (2000) and Tapscott's (1998) perspectives about students who are growing up digital, as these studies or perspectives should be read by every professor and every administrator because they reveal more about our students' real capabilities in the classroom than simple objective statistical demographic descriptors. (The research reported here also deeply supports the teaching and learning changes targeted by our initiative.)

Although we have, probably, a higher number of Millennials entering our classrooms today and for the next few years, there are also many Boomers returning, and many Generation Xers either returning or coming to college after working for some years. By 1994, "44% of all college students were over twenty-five years old; 54% were working; 55% were female; and 43% were attending part time; fewer than one in six of all current undergraduates [at that time] fit the traditional stereotype of the American college student attending full time, being eighteen to twenty-two years of age, and living on campus" (U.S. Department of Education, 1996b as cited in Levine & Cureton, 1998, p. 49). Therefore, all three generations and other contextual factors are considered and woven into the information presented below. However, for those who may question the more qualitative approach to defining student profiles, the tables below first present the typical statistical information on our CEET students.

Table A.4.1: Percentages of Transfer/Native Undergraduates in Fall 2006

	College						
	BUS	**EDU**	**VPA**	**LAS**	**HHS**	**EET**	**All Undergraduates**
Transfer Students	**34.8**	**46.2**	**36.6**	**44.0**	**40.2**	**38.1**	**39.2**
Native Students	**65.2**	**53.8**	**63.4**	**56.0**	**59.8**	**61.9**	**60.8**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table A.4.2: CEET Student Demographics

2005 Major 2006 Major	FEMALE		MALE		TOTAL			2005-2006 ACT Composite Mean		SD		N	
ELE	21	15	295	251	316	266							
	7%	6%	93%	94%	100%	100%		23.02	23.62	3.70	3.56	223	184
ING	11	14	71	59	82	73							
	13%	19%	87%	81%	100%	100%		23.61	23.37	3.48	3.79	56	51
MEE	30	23	388	393	418	416							
	7%	6%	93%	94%	100%	100%		24.14	24.27	3.53	3.51	332	314
TECH	20	15	317	291	337	306							
	6%	5%	94%	95%	100%	100%		21.00	21.22	3.72	3.56	230	202
UNDE-CIDED E&ET	2	3	17	68	19	71							
	11%	4%	89%	96%	100%	100%		22.38	24.07	4.51	3.49	16	57
Total	84	70	1088	1062	1172	1132							
	7%	6%	93%	94%	100%	100%		22.94	23.29	3.85	3.75	857	808

Table A.4.2: CEET Student Demographics (continued)

2005 Major 2006 Major	AMERICAN INDIAN OR ALASKAN NATIVE		ASIAN OR PACIFIC ISLANDER		BLACK-NOT HISPANIC		HISPANIC		NOT GIVEN		OTHER		WHITE/NOT-HISPANIC		Total	
ELE	**1**		**44**	**31**	**42**	**36**	**26**	**14**	**7**	**3**	**6**	**4**	**190**	**178**	**316**	**266**
	0%	**0%**	**14%**	**12%**	**13%**	**14%**	**8%**	**5%**	**2%**	**1%**	**2%**	**2%**	**60%**	**67%**	**100%**	**100%**
ING			**9**	**10**	**9**	**7**	**10**	**7**	**3**		**2**	**3**	**49**	**46**	**82**	**73**
	0%	**0%**	**11%**	**14%**	**11%**	**10%**	**12%**	**10%**	**4%**	**0%**	**2%**	**4%**	**60%**	**63%**	**100%**	**100%**
MEE		**2**	**44**	**47**	**23**	**28**	**28**	**28**	**7**	**7**	**6**	**6**	**310**	**298**	**418**	**416**
	0%	**0%**	**11%**	**11%**	**6%**	**7%**	**7%**	**7%**	**2%**	**2%**	**1%**	**1%**	**74%**	**72%**	**100%**	**100%**
TECH			**22**	**18**	**69**	**59**	**23**	**22**	**3**	**3**	**4**	**5**	**216**	**199**	**337**	**306**
	0%	**0%**	**7%**	**6%**	**20%**	**19%**	**7%**	**7%**	**1%**	**1%**	**1%**	**2%**	**64%**	**65%**	**100%**	**100%**
UNDE-CIDED E&ET	**1**			**3**	**3**	**8**	**2**	**5**	**1**			**2**	**12**	**53**	**19**	**71**
	5%	**0%**	**0%**	**4%**	**16%**	**11%**	**11%**	**7%**	**5%**	**0%**	**0%**	**3%**	**63%**	**75%**	**100%**	**100%**
Total	**2**	**2**	**119**	**109**	**146**	**138**	**89**	**76**	**21**	**13**	**18**	**20**	**777**	**774**	**1172**	**1132**
	0%	**0%**	**10%**	**10%**	**12%**	**12%**	**8%**	**7%**	**2%**	**1%**	**2%**	**2%**	**66%**	**68%**	**100%**	**100%**

Table A.4.3: Cumulative GPA

	2005-2006 Cumulative GPA					
	Mean		SD		N	
ELE	2.53	2.52	0.75	0.75	314	263
ING	2.46	2.50	0.80	0.86	82	73
MEE	2.59	2.54	0.76	0.78	414	407
TECH	2.64	2.68	0.71	0.75	335	304
UNDE-CIDED E&ET	2.46	2.35	0.75	0.90	19	68
Grand Total	2.58	2.56	0.75	0.78	1164	1115

Table A.4.4: Semester GPA

	2005-2006 Semester GPA					
	Mean		SD		N	
ELE	2.36	2.33	1.01	1.03	314	263
ING	2.42	2.49	1.05	1.08	82	73
MEE	2.45	2.34	0.97	1.01	414	407
TECH	2.73	2.77	1.00	1.00	335	304
UNDE-CIDED E&ET	2.11	2.29	1.07	1.00	19	68
Grand Total	2.50	2.46	1.01	1.03	1164	1115

Table A.4.5: HS Percentile Rank

	2005 -2006 HS Percentile Rank					
	Mean		SD		N	
ELE	0.65	63.82	0.20	20.23	207	165
ING	0.63	63.31	0.19	18.79	57	48
MEE	0.68	66.98	0.18	19.08	305	293
TECH	0.60	59.04	0.19	19.61	221	199
UNDE-CIDED E&ET	0.54	67.53	0.23	19.63	17	59
Grand Total	0.64	64.04	0.19	19.72	807	764

Table A.4.6: Financial Aid

Financial Aid FY 1977-2006									
	Grants, Scholarships, Other Gifts		Loans		Employment		Total Financial Aid		% of UG
Fiscal Year	Recipients	Award per Recipient	Recipients	Award per Recipient	Recipients	Award per Recipient	Recipients	Award per Recipient	Receiving Aid
1985	6,043	1,420	6,448	2,086	4,843	696	12,485	2,035	70.7
1986	6,077	1,712	6,560	2,058	6,207	602	11,766	2,349	64.6
1987	6,091	1,696	5,747	1,879	5,021	731	10,475	2,368	56.8
1988	5,925	1,900	5,426	1,864	4,574	781	9,854	2,531	52.0
1989	5,988	2,019	4,417	2,107	4,179	858	9,618	2,597	53.1
1990	6,358	2,243	4,497	2,300	4,220	967	10,753	2,667	59.6
1991	6,472	2,332	5,193	2,429	4,715	920	11,449	2,799	62.8
1992	6,102	2,872	5,083	2,838	4,235	1,007	9,879	3,666	54.2
1993	6,577	3,148	4,266	3,266	5,003	841	10,067	3,858	59.9
1994	6,683	3,221	5,812	3,634	4,303	1,067	10,432	4,528	62.1
1995	6,946	3,337	6,113	3,919	4,269	1,061	10,847	4,763	66.0
1996	6,955	3,490	6,579	4,110	4,076	1,103	10,876	5,136	70.7
1997	7,014	3,795	7,177	4,029	4,044	1,186	11,226	5,374	73.0
1998	9,008	3,099	7,303	4,297	4,364	1,362	11,101	5,877	70.0
1999	9,274	3,350	7,678	4,630	4,540	1,316	11,489	6,318	70.3
2000	9,432	3,484	8,035	4,799	4,258	1,687	11,764	6,682	69.6
2001	9,895	3,808	8,211	5,203	4,317	1,651	12,161	7,197	70.9
2002	10,059	4,079	8,529	5,491	4,030	1,748	12,484	7,602	71.5
2003	10,174	4,088	9,292	5,699	3,667	1,827	12,864	7,871	71.1
2004	10,537	4,217	9,851	6,179	3,763	1,883	13,238	8,490	72.5
2005	10,442	4,186	9,971	6,882	3,841	2,053	13,175	9,124	73.1

Figure A.4.1: Recipients of Undergraduate Financial Aid, FY 1977-2005

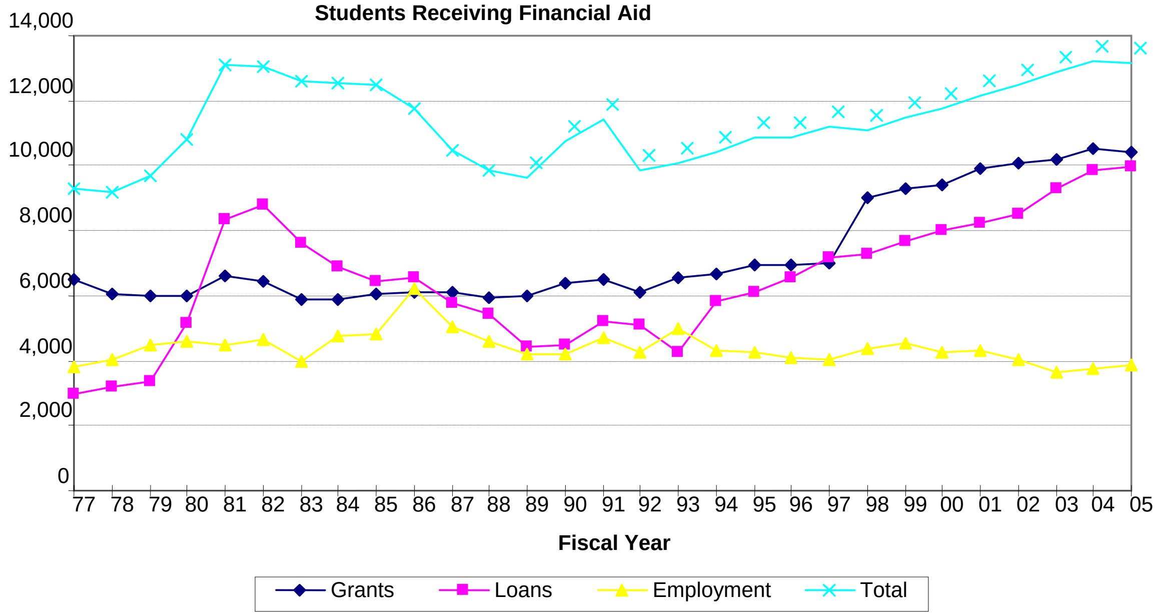
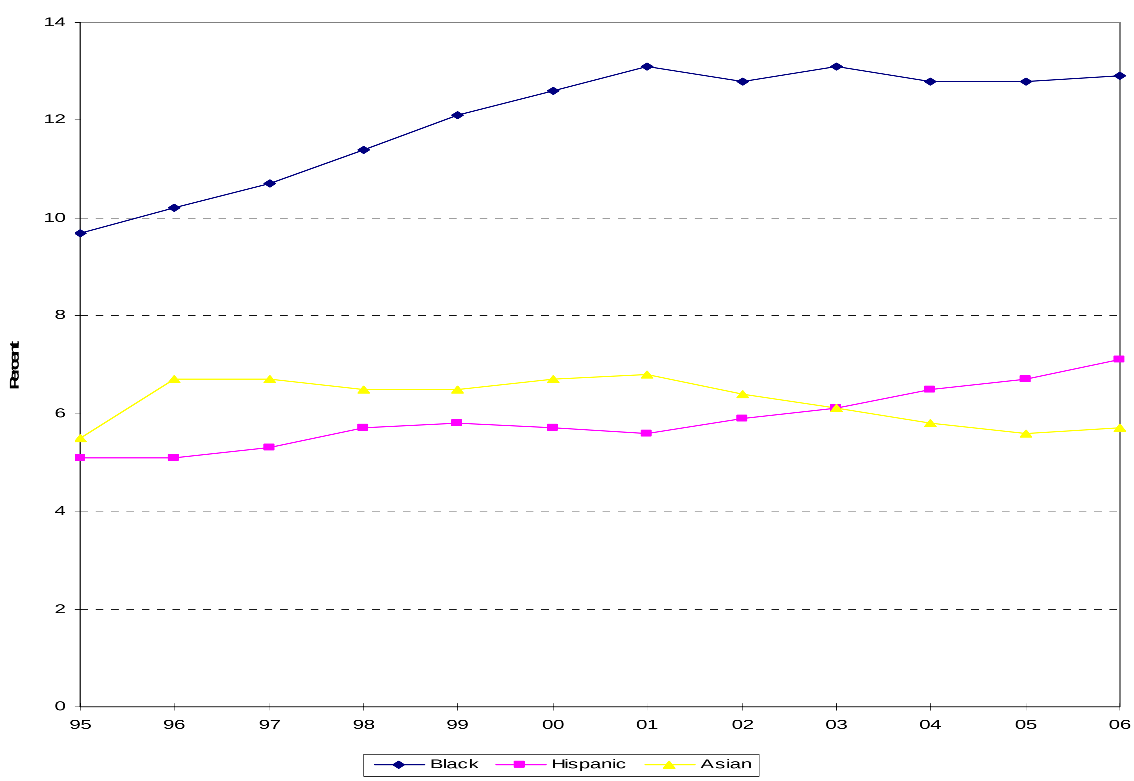


Figure A.4.2: Undergraduate Enrollment by Racial/Ethnic - Fall 1996 - Fall 2006



NIU Freshmen Survey Summary

The statements below provide a more personal perspective about CEET students. Only the summary statements that mention CEET students were selected from the NIU report, as those reflect the self perspectives of potential engineering and technology majors who responded to the NIU Freshman Survey (House & Xiao, 2006, pp. 5-9):

1. *The percentage of NIU freshmen who rated themselves as above average or top ten percent on computer skills was highest for the College of Engineering and Engineering Technology (57.5 %) and was lowest for the College of Health and Human Sciences (33.3%).*

2. *The percentage of NIU freshmen who rated themselves as above average or top ten percent on drive to achieve was highest for the College of Health and Human Sciences (76.1%) and was lowest for the College of Engineering and Engineering Technology (64.7%).*

3. *The percentage of NIU freshmen who rated themselves as above average or top ten percent on mathematical ability was highest for the College of Engineering and Engineering Technology (76.5%) and was lowest for the College of Education (25.8%).*

4. *The percentage of NIU freshmen who rated themselves as above average or top ten percent on writing ability was highest for the College of Liberal Arts and Sciences (59.4%) and was lowest for the College of Engineering and Engineering Technology (37.3%).*

5. *The percentage of NIU freshmen who indicated that their highest degree planned at NIU was a master's degree was highest for the College of Engineering and Engineering Technology (51.0%) and was lowest for the College of Visual and Performing Arts (10.7%).*

6. *The percentage of NIU freshmen who indicated that a very important reason for selecting NIU was a teacher's advice was highest for the College of Visual and Performing Arts (12.8%) and was lowest for the Colleges of Engineering and Engineering Technology (2.7%).*

7. *The percentage of students who rated that the cost of attending this college was a very important reason for selecting NIU was highest for the College of Health and Human Sciences (42.8%) and was lowest for the College of Engineering and Engineering Technology (31.8%).*

8. *The percentage of students who indicated that a very important reason for selecting NIU was the advice of a high school guidance counselor was highest for the College of Education (14.2%) and was lowest for the College of Engineering and Engineering Technology (2.7%).*

9. *The percentage of students who indicated that size of college was a very important reason for selecting NIU was highest for the College of Liberal Arts and Sciences (34.4%) and was lowest for the College of Engineering and Engineering Technology (24.0%).*

10. *The percentage of students who rated their chances as very good that they would transfer to another school was highest for the Engineering and Engineering Technology (9.3%) and was lowest for the College of Health and Human Sciences (2.9%).*

11. *The percentage of students who rated their chances as very good that they would be satisfied with their institution was highest for the College of Education (56.7%) and was lowest for the College of Engineering and Engineering Technology (36.8%).*

12. *The percentage of students who indicated that they considered it very important or essential to influence the political structure was highest for the College of Liberal Arts and Sciences (28.5%) and was lowest for the College of Engineering and Engineering Technology (15.1%).*

13. *The percentage of students who indicated that they considered it very important or essential to influence social values was highest for the College of Liberal Arts and Sciences (50.2%) and was lowest for the College of Engineering and Engineering Technology (29.3%).*

14. *The percentage of students who indicated that they considered it very important or essential to help others in difficulty was highest for the College of Health and Human Sciences (81.1%) and was lowest for the College of Engineering and Engineering Technology (53.3%).*

15. *The percentage of students who indicated that they considered it very important or essential to develop a meaningful philosophy of life was highest for the College of Visual and Performing Arts (50.3%) and was lowest for the College of Engineering and Engineering Technology (35.8%).*

16. *The percentage of students who indicated that they considered it very important or essential to participate in community action program was highest for the College of Liberal Arts and Sciences (24.7%) and was lowest for the College of Engineering and Engineering Technology (17.3%).*

17. *The percentage of students who indicated that they considered it very important or essential to promote racial understanding was highest for the College of Visual and Performing Arts (42.9%) and was lowest for the College of Engineering and Engineering Technology (20.7%).*

General Characteristics

Boomers

After studying college students of the 1970s (the Boomers), Levine (1980) reported the results in *When Dreams and Heroes Died*. His report portrayed them as optimistic about their own futures, but not about the country – having a rather dooms-day perspective. Thus they turned inward, focused on themselves and their vocations, making material goods of great importance. Vietnam and Watergate set the tone of their perspectives, slightly or greatly negative. This generation was short on heroes, and their political attitudes were conservative. They were less well prepared academically; the social sense of community on campuses declined; individualism dominated. Individual sports grew; students became more socially liberal; clubs developed around gender, race, religion, and ethnical differences. Individual rights and freedoms became more important, and liberalization of sex, divorce, marijuana, etc. increased. Thus they turned inward, focused on themselves and their vocations, making material goods of great importance. Levine (1980) continued to study college students during the 1980s, asking the same set of questions. They kept giving him essentially the same answers with an exception. A higher proportion said it was essential or very important to be very well off financially and the number who felt that way kept rising throughout the study.

Gen X

When continuing with the 1990s students, the answers began to show “dramatic changes regarding optimism about the future, social involvement, and life goals” (Levine & Cureton, 1998, p. xiii). Levine was joined by a colleague, Cureton, and together they repeated the research of the 70s study. *When Hopes and Fear Collide* (1998) presents their findings. Beginning with the issues of the “Generation without a name” (Generation X, the Lost Generation, or the 13th Generation), these students, born in the late 70s and early 80s, attended college in the mid- to late-1990s. We have had them in our classrooms for a number of years now (a small generation, the upbeat and downwardly mobile generation, the “we don’t have a clue generation”) and were described as optimistic about their future, having expectations to live as well as their parents, and feeling they had career potential; most importantly, they rejected the claims of the ‘me’ generation. They were not optimistic about the country’s future and were focused on having interesting lives where personal preferences took first place over a job. They believed education was the pathway to money as well as personal growth. Close approximations of this description were published both by *Fortune*

and *Time* magazines (Hornblower, 1997 as cited in Levine & Cureton, 1998, p. 5; see also Deutschman, 1992); however, *Business Week* described the same generation as

> shut out, angry, neglected, and pessimistic about their personal futures…destined for mundane and marginally challenging work that provides a paycheck and little else…more likely than past generations to be unemployed, underemployed, and living at home after completing school…a generation that resented the baby boomers for blocking their career paths…economically at risk…emotionally unstable. (Zinn, 1992, p.76 as cited in Levine & Cureton, pp. 5-6).

Levine and Cureton felt there was some truth in both perceptions.

Brandweek called Gen Xers "a complex mix of contrasts" (Benezra, 1995, p.34 as cited in Levine & Cureton, 1998, p. 7). As this group is somewhat waning in our classrooms, I will spend less time on them than the following group, the Millennials; however, we are still teaching the Xers, so some time on them is still important. This generation lived through profound change: demographically, socially, globally, economically, and technologically. They are the smallest generation; the racial numbers shifted, with Hispanics growing by 42% and Asian Americans rising by 100% - a sharp rise in the number of teenagers of color. This generation has lived in a racially and ethnically politically charged world, dramatically different than their parents or the adult generations, and they were not prepared to respond to the new conditions. They endured the first quarter of the "American Century," where the U.S. economic supremacy waned, the national trade debt soared, dollar declined, purchasing power parity shifted and declined, trade balances shifted negatively, consumer prices soared, and poverty rates increased, with those in poverty increasing about 50%. They were in college at time when the nation's economy worsened. This caused them to worry greatly about their futures, jobs, economic security (their and the country's), being able to afford a home and family, and technological change at an unprecedented rate, as well as national failures of great magnitude (e.g. chemical leaks, nuclear accidents, oil spills, a space shuttle explosion, politically charged international events with other countries, and environmental issues). Also turbulent were global changes such as unification, atomization, alliances, civil collapses – ethic cleansing, international trading bloc development, and wars. Communication changed dramatically – the quiet revolution. This technology brought the accidents, failures, and catastrophes around the world to them, while they were very young, right into their homes more dramatically than any other generation had experienced. They came to fear disasters as they questioned whether they would be able to live in such a world. There seemed to be no order to things in their lives. And, in fact, a new world order was formed as they grew into adults, where the position of the US could no longer be clearly defined and seemed far from as strong. Their "streets became more dangerous"; the place of religion in their lives diminished. Everything seemed to be changing for the worse. Levine and Cureton compare the time of the Generation Xers to the "Rip Van Winkle" story where he slept for 20 years and woke up to a completely changed environment – everything was strange. They, however, remain energized by their desire for a good life and to make their world a better place. "This is a generation in which hope and fear are colliding" (p. 17).

Levine and Cureton (1998) went on to study undergraduate students between 1993 and 1997. When asked what social and political events had an impact on their lives, students responded consistently with negative examples and expressed the situation as

- Our experience is of flaws, problems, and decline. We're not number one in anything. Our generation grew up with that.
- The world seems to be falling apart.
- We don't have anything that [is] stable to hold on to.
- Rome and Greece fell; so can the U.S. (p. 28)

Their greatest and strongest criticism was of the government and political system – believing that nothing works and that social change cannot happen with the present politics. Family values are breaking down, people are self focused, the news is biased, and private corporations are more concerned about profits than public responsibility. Doctors are too motivated by money, not enough by helping people. Political leaders do not have integrity, and executives deserve the high salaries they are receiving. Congress has the people's interests at heart. However, these same students are very optimistic about the future: "I expect things to get worse before they get better," "I'm pragmatically optimistic," and, the favored response by the authors, "I am cynically optimistic" (p. 29). These Gen Xers' responses differed greatly from the Boomers and also from the Millenniums (Howe & Strauss, 2000) to be discussed below. The Boomers' responses were more negative and less hopeful. The Gen Xers have a greater sense of efficacy, believing that they can make a difference individually. When asked how they could be so negative about the social and political institutions yet so positive about their future and change, they responded:

- Our generation is getting more involved.
- The younger generation will is more concerned with the planet.
- Our generation will be able to fix the problem.
- Our generation will do things.
- Our generation works hard. We will do something.
- We are the future…Our generation cares about the country and society.
- Our generation will make a revolution. (p. 30)

The authors felt that student attitudes did not fit within traditional labels and that undergraduates were both more liberal and more conservative. What might be called the political center shifted, and although they seemed to be polarized ideologically, their opinions were very similar – they desired change. This group, Xers, did not believe in the government's ability to fix things and felt they had to make the changes. Their visions were small, pragmatic, and manageable, "I can't do anything about the theft of nuclear-grade weapons materials in Azerbaijan, but I can clean up the local pond, help tutor a troubled kid, or work at the homeless shelter" (p. 36). This differed from the responses of the 70s and 80s. The 90s groups named heroes who were more local and that they personally knew, rejecting the "larger than life" people as "inaccessible…up on a pedestal"; as compared with the 70s and 80s, whose heroes were named as no one, God, entertainers, athletes.

A significant majority of students in the 1993 phase of the studies had at least one friend of another race; were comfortable expressing controversial viewpoints; were comfortable with interracial dating; felt a sense of community when on campus; and did not feel uncomfortable socializing with students different racially from themselves. In 1997, however, a majority of deans at four year colleges described things differently:

> the climate on campus was politically correct; civility has declined on the college campus; students of different racial and ethnic groups do not often socialize together; reports of sexual harassment have increased; and students feel uncomfortable expressing unpopular or controversial opinions. And although not the majority, a significant number of deans felt that there is greater racial tension and more victimization and that diversity is the main cause of conflict between students on campuses. (pp. 71-72)

The deans' perspectives were diametrically different than how the students responded. Levine and Cureton (1998) identified four characteristics that exacerbated causes of multicultural tension: Preoccupation with Differences; Mitosis of Student Groups, meaning that differences among students were growing, resulting in students defining the proportion of students as being "like me" as reduced, and changing their perspectives as the number of students who are "different from me" is increasing in number (p. 85). The undergraduates responding in the 1993 study viewed themselves as lonely, with few people like themselves. The third characteristic was that there was great segregation on campuses – voluntarily segregated with "locations" on campus belonging to particular groups and where students group by like kind. This was greater the larger the institution. Finally, the fourth characteristic was the growing sense of victimization.

> A rising percentage of undergraduates felt they were being disadvantaged to the perceived advantage of other students. For example, affluent students complained that they were being made to pay higher tuition to support less affluent undergraduates. Poorer students said admissions standards were less rigorous for students who can pay full tuition. Men pointed fingers at women, who they felt had preference in entering traditionally male professions, and women pointed back at men, talking of the glass ceiling they experienced. Racial majorities charged that minorities were being advantaged at their expense, and minorities made the reverse claim. International students were critical of domestic populations and vice versa. One religious group complained about the preferential treatment given the next. (pp. 90-91)

In summary, undergraduate students felt they were being treated unfairly and others were being treated better at their expense, whoever they were. Focus was reported on differences rather than commonalities, isolation between groups was unbridgeable, with greater separation of groups, leading possibly to "Hobbesian worlds" – all against each other (p. 91). Multiculturalism was the greatest issue on campuses in the 1990s (and possibly still today). In my more diverse classrooms, it is extremely difficult to get particular groupings of students to break apart and mix more in the required group activities. I have to systematically struggle, artificially, to make that happen to diversify the individuals in groups for group work.

An important understanding of the Generation X (1990s) students is reflected in their personal lives. For the Generation Xers, the best descriptor over all is "overwhelmed and more damaged" (p. 91). Classroom impacts range from higher disruption rates, drug abuse, alcohol abuse, and gambling and suicide. Deans report that students have more baggage, there are more developmentally disabled students, and they are spending more time on

emotionally-ill students. Students have more nonacademic issues, student discipline takes more time, and students really expect the community to help make things right for them:

- "I don't have a social life."
- "There is no free time."
- "My whole life is juggling."
- "Study, that's all we ever do."
- "I'm always behind. I never catch up."
- "I feel run down."
- "People's lives are dictated by their jobs."
- "The high cost means I have to work forty to fifty hours per week, and it's killing me. Sometimes I fall asleep in class…life is just work, school, and home" (pp. 99-100)

Gen Xers, as reported in the 1990s, were optimistic about their futures and wanted good jobs, successful relationships, children, and to live as well as their parents (the Boomers). Their fears were summed up as nothing was tangible for them to hold on to. They were more positive than their predecessors, and somewhat optimistic, yet they were worried about the government and politicians, etc. They were also worried about their private lives but believed they would be successful. "This is a generation that is desperately clinging to its dreams, but their hope, though broadly professed, is fragile and gossamer-like. Their lives are being challenged at every turn: in their families, their communities, their nation, and their world. What is remarkable is that their hopes have not been engulfed by their fears" (Levine & Cureton, 1998, p. 145). In concluding, these authors label this generation as a transitional generation in a time of discontinuity, a rare time of profound change in our society (and the world). Levine and Cureton note the enormous size of the population attending college, which reduces the benefit of a college education, ending that undergraduates need an education that provides four things: hope, responsibility, an appreciation of differences, and efficacy or the sense that one can make a difference. Levine and Cureton end with recommendations for a curriculum that includes communication and thinking skills, with a focus on fluency in words and numbers; transitional and critical thinking skills; and continuous learning with creativity as highly essential. Students must learn how to access knowledge and use it, knowledge and context that are forever changing and more complex. The other elements important to study are human heritage, past and present; the environment, as this is a "green" generation; scientific literacy; an understanding of the multifaceted roles that we play as individuals; and values (because if students are to value differences and respect one another or understand why cheating is wrong, values must be included in the curriculum). Levine and Cureton's research, although primarily about Generation X, is truly insightful and reveals a great deal to consider, even when faculty have begun to teach an entirely new generation, the Millennials – those who have grown up digitally.

Millennials

Howe and Strauss (2000) discuss several generations in several different books: *Generations, 13th Generation* and *Millennials Rising-The Next Great Generation.* The newest generation, born from 1982 forward and now accepted as the "Millennials," is in college. Eighteen in 2000, they either have just or are about to graduate from college, depending upon the number of years in college (4-6). From a slightly different perspective, Howe and Strauss argue that the Millennials are quite different in persona than the Boomers and Xers. Where the two previous generations tended towards "more selfishness in personal manner, more

splintering in public purpose, more profanity in culture and daily discourse, more risk-taking with sex and drugs, more apathy about politics, and more crime, violence, and social decay, the Millennials – the ‘good news revolution,’” from Howe and Strauss’ perspective, represent a counter culture considered to be the “found” generation versus the “lost” generation. The Millennials are “optimists,” more upbeat, confident, and positive, and the number who worry about violence, sex, and drugs is rapidly decreasing. They feel that growing up was easier than it was for their parents. The Millennials are cooperative and team players and gravitate toward group activity and criticize “selfishness.” They are not “self-absorbed” and accept authority. They identify with their parents’ values and “trust and feel close to” their parents. Half trust the government to do what is right most of the time and believe that lack of parental discipline is a major social problem. A large majority favor “tougher rules against misbehavior in the classroom and society at large” (p. 8). Millennials are “rule followers,” as the homicide rates, violent crime, abortion, and pregnancy among teens have all decreased very significantly in the last five years. This is not a “neglected” generation, as “they are the most watched over generation in memory” (p. 9). These kids have more structure and supervision by parents and relatives, teachers, sitters, etc. as well as more curfews and surveillance cams than any group so far (pp. 8-9). Millennials are also smarter than we think. Aptitude test scores have risen with all racial and ethnic groups, and this generation thinks it is cool to be smart, with a record number taking AP tests, and “look[ing] forward to going to school,” planning to attend college. There is an increase in math and science exam scores, with fourth graders near the top internationally. With the amount of homework on the increase and the new standards, they could stay on top.

The Millennial Generation “believe in the future and see themselves as its cutting edge” (p. 10). Why are they so different than expected? Howe and Strauss (2000) feel that it is because the predictive assumption that the future will be a “straight-line extension of the recent past that never happens” is wrong (p. 10). So the Millennial Generation is just as the other generations: the “Silent Generation” (the Boomers’ parents), the Baby Boomer Generation, the Generation Xers – very different from the others. The Millennials rejected the name “Generation Y” or “Echo Boomers” because the Generation Y name had a negative connotation and did not express their uniqueness. They wanted a “founding word…that respects their newness, a word that resets the clock of secular history around their own timetable…Millennial acknowledges their technological superiority without defining them too explicitly in those terms…hints at what their rising generation could grow up to become….‘We’re the kids who are going to change things’” (pp. 10-12). In society, the Millennials have been regarded as special since birth and have been more obsessed over at every age than the Xers, which partly explains why harms against children are less tolerated today than 10 years ago. Political issues have been recast: “kinder politics, as in: If it’s good for children, do it – and if it isn’t, don’t” (p. 13).

Howe and Strauss (2000) describe this generation as “numerous” because of resurgent fertility rates and large families from a record immigration surge, 76 million at 2000. With 2002 as their final birth year, they will outnumber Xers as well. Add that to additional immigration numbers and they may become America’s first 100 million person generation. This IS America’s most ethnically diverse generation and least-Caucasian generation. One Millennial in every five has at least one non-citizen parent; this is possibly the largest second-generation immigrant group in U.S. history, and they are the first group to think of

itself as global (p. 16). America is “browning,” irreversibly, and they growing up thinking of themselves as global. This is and can be an amazing group, and WE are responsible for their education, development, vision, potential and ultimately their future. Howe and Strauss discuss in great depth these generations, giving in-depth consideration to the potential and power of the Millennials as

- *Special*. …older generations have inculcated in Millennials the sense that they are, collectively, vital to the nation and to their parents’ sense of purpose.
- *Sheltered*. …are the focus of the most sweeping youth safety movement in American history.
- *Confident*. With high levels of trust and optimism – and a newly felt connection to parents and future – Millennial teens are beginning to equate good news for themselves with good news for their country. They often boast about their generation’s power and potential.
- *Team-oriented*. From Barney and soccer to school uniforms and a new classroom emphasis on group learning, Millennials are developing strong team instincts and tight peer bonds.
- *Achieving*. With accountability and higher school standards rising to the very top of America’s political agenda, Millennials are on track to become the best educated and best behaved adults in the nation’s history.
- *Pressured*. Pushed to study hard, avoid personal risks, and take full advantage of the collective opportunities adults are offering them, Millennials feel a “trophy kid” pressure to excel.
- *Conventional*. Taking pride in their improving behavior and more comfortable with their parents’ values than any other generation in living memory, Millennials support convention – the idea that social rules can help. (pp. 43-44)

The trends of the Millennials will become more obvious with each birth cohort and represent “a direct reversal of the Boomers and Xers” (Howe & Strauss, 2000, p. 84). Names clearly reflect globalism and diversity. Important to note, but rarely discussed regarding immigration numbers, is that there are also significantly more Americans being born abroad. In 2000, only 2.4 million Millennials (3.5 percent of the entire generation) were themselves immigrants. However, approximately 14 million Millennials were the “children” of immigrants, mostly Gen Xers, growing by half since 1990 and now about 20 percent of this generation (it was 6-8 percent for Boomers). Therefore, more Millennials can be expected to immigrate to the U.S. Although Gen Xers will remain the largest “first” generation immigrant cohort group to preserve their native cultures, Millennials are going to be a greater “second” generation immigrant group and will probably be “assimilationists” (p. 84). A large number of Millennials will be the children of foreign born Gen Xers, and although these students may have to endure hardships even though here in the U.S. (e.g., poverty, no health care, material hardships), their families are stable and have a dedicated work ethic. They have aspirations, will do well in school, and will be arrested less than the third or fourth generation of the same ethnic group.

Millennials fit the general pattern of second-generation immigrants; they trade the language and culture of their parents’ nationalities for that of the U.S. Many do not speak English at home, but they show more “rapid linguistic assimilation” across all ethnicities and socioeconomic levels than past immigrant children. Because Latino immigrants have become

so large in number and have such a high fertility rate (double that of American mothers – two per mother), they have significantly increased the Millennial generation birth boom, especially that of the 90s, resulting in "a geographic nexus of Millennial brownness" (Howe & Strauss, 2000, p. 85). These families demographically are "mixed status." They have family anchors in the U.S. because of having a child that is a U.S. citizen, but the parents may not be citizens. As a result of the changes in law during the 1990s, the "mixed status" children who are citizens were granted an advantageous and vast array of cash payments and government services denied to their undocumented parents. This makes Millennials in the U.S. historically by far the most racially and ethnically diverse generation; nearly 35% of the Millennials are nonwhite or Latino versus 14% of the Boomers (p. 85). Not much of the "browning" or change comes from African Americans, whose fertility rate has fallen during the past decades; they gain little from the immigration influx. The "browning" is primarily Latino with some Asian influence. As a result, African Americans are no longer the largest minority; Latinos have replaced them. An aside, where the civil rights slogan for African Americans has been "We shall overcome," the civil rights slogan quoted from the Latina magazine is "Ours is going to be 'We shall overwhelm.'" Regardless of the race or ethnicity, Millennials across the world share being the "more wanted, protected, and cared for generation" (p. 86).

As a result of growing up in a politically correct environment, Millennials are removed from understanding government, causes, etc. What they have heard about major national/global civic events has been through cynicism, irony, satire, and parody – pop culture. This made it seem that not much is really at stake. That, however, does not mean that they are not respectful; perhaps they cannot relate to the underlying issues. From their perspective, the Millennials feel adult generations have accomplished some good that has enhanced their (Millennials') lives and potential futures. Millennials also find fault with the self-centeredness of the adult generations, often feeling that the nation has been left with pointless arguments, hypocrisy, and fragmentation – pieces that do not fit together any more. This is partly why the Millennials are finding a role; they have civic spirit and are accomplishing things crossing racial and gender boundaries, engaging in community service, politics, and faith. They have already begun to face a different set of challenges than that of the adult generations.

From our perspective in higher education, the Millennials may represent a somewhat better educated student, one better prepared for college. The oldest of these students were only one year old when the report *Nation at Risk* came out, followed by the national calls for reform, e.g. Goals 2000. Hopefully, as reported by *U.S. News*, we are now in an "age of accountability," where education is showing some improvement and a very significant change in teacher attitudes (teachers say they would be a teacher again). More teachers now have master's degrees, from one sixth to over half now. Also teaching is now, again, considered a profession with "meaning." Many Teach for America Gen Xers as well as many burned-out Boomers have entered the classroom to make a difference with their lives (Howe & Strauss, 2000, pp. 146-147).

We are now teaching students who are and have been digital learners. Brown's (2000) article in *Change*, "Growing up Digital-How the Web Changes Work, Education and the Ways People Learn," validated some prior learning theory on constructivism, active learning, and

engagement and focused on the World Wide Web as a transformative medium and on what that means for learning. The students are linked to the Internet in many ways. Tapscott (1998), in *Growing Up Digital – The Rise of the Net Generation,* terms the digital generation as the “N-Geners,” today’s media-literate kids, which goes far beyond technological literacy in using computers and the past “uni-directional technology” that was often “dumbed down to the lowest common denominator” (p. 2). Digital-savvy N-Geners require interactive media, where users are not just viewers or listeners and where the digital wave is swallowing TV. Children today are watching less TV as new media penetrates households. Although Tapscott seems to consider Gen Y as the digital generation, the ages he discusses seems to include some Gen Xers. (Perhaps, this “Net generation” merges those from the X and Millennial generations.) However, he does comment that Net as a demographic codifies and unifies the power of demographics with the power of new media analysis, breaking from the cynicism surrounding Gen X. He feels the N Generation defines positively. Boomers were the TV generation, which at the time reshaped and transformed businesses, communication, education, and more. The Net has now caused yet another profound transformation because of its wireless capabilities and has had even greater impact because of the capability for immediate global interaction and access to information. This greatly changes the demographics of the students in our classrooms. The Net Generation is “breaking free from the one-way, centralized media of the past and is beginning to shape its own destiny. Some argue that there is mounting evidence that the world will be a better place. Technology is transparent to them, simply the vehicle for the trip; it is like “air” (p. 39). However, they do want to know how computers and software work so they can change or modify it, not just use it. N-Geners do not really see the technology; it is almost irrelevant; they merely see all the connections they can make, people, information, games, applications, services, friends, and protagonists at the other end (p. 39). They do not register the “screen”; they see what is happening and the people and information that the screen helps them to access. They are more focused on what they are doing. Digital media or revolution is not controlled by adults. Children and young adults are becoming experts on topics, acquiring knowledge and experience completely differently, and they are being taken more seriously when they use what they have learned. They can engage in justified argument backed up with the latest information. The culture has also been transformed because of the Net interaction. Descriptors of the N-Gen Culture offered by Tapscott are

- Fierce independence
- Emotional and intellectual openness
- Inclusion
- Free expression and strong views
- Innovation
- Preoccupation with maturity
- Investigation
- Immediacy
- Sensitivity to corporate interest
- Authentication and trust

They can challenge corporations on value and results. Also because anyone can say anything (true, accurate, or not), they are seekers of authenticity of what they learn from the Net.

Authenticity leads them to trust. N-Gen personalities are presented as accepting of diversity, a curious generation, and assertive and self-reliant.

They are a “contrarian” generation because they have the tools to question, challenge, and disagree; they are critical thinkers. Tapscott (1998) feels this is vital to the future of humanity (p. 88). The Net provides the venue for millions to argue worldwide and in real-time. The N-Geners can build higher self esteem with Net “friends.” Although not always positive, they can also present multiple selves, experiment with morphing their own identities. Tapscott feels the Net builds and allows the use of multiple intelligences and presents the results of some studies that show if students can have access to computers that “alone could displace other factors, such as household income, in improving writing skills” (p. 99). In 1998, 47% of the U.S. population demonstrated low or no levels of literacy. Today’s rates are reported in four categories: below basic – illiterate (14%), basic – can understand simple documents and brochures (28%), intermediate – understand articles and find reference materials (43%), proficient – capable of critical thinking (13%). According to the 2002-2003 National Assessment of Adult Literacy – a division of the National Center for Education Statistics (2006), results about 42% of adult Americans do not meet the full prose literacy expectations of high school graduates and that rating dropped by 1% by 1998 and 2003. N-Geners do seem to lack appreciation for global distances, possibly the first generation to have a global perspective. Spatial orientation with the immediate environment is a different question. There is a difference in thinking and processing of information because the N-Gen processes multiple types of information concurrently and less sequentially; they can organize complex structures of information and also link to other sources of information concurrently, possibly freeing them from linear thinking. The link between input and output, processing – cognition and reasoning is also being transformed. This can result in more easily establishing relationships between knowledge pieces and building more complex schemas where knowledge is more easily connected, expanded, and used across more widely varying contexts.

The N-Geners, however, may be less socially skilled; their attention spans may be reduced, and they can become vain about their prowess (e.g., own web pages). They either relieve stress or build more stress by interacting with the Net, as its use consumes time in an already over-scheduled day. This generation has become addicted to the Net. Learning is changing, especially learning in a knowledge-based economy. The Net has challenged education, content and process, and even nine years after Tapscott’s (1998) work, we are only just beginning to get to the more relevant questions. It has already transformed our students’ learning, and although we are making progress, our content and process has not been transformed so easily, quickly, or well. We are still in crises in K-12, and those crises have followed into higher education as well. The entire purpose of educational institutions is at question. At the heart of the broader question is that learning is social and interactive. The old, yet renewed, best practices in teaching and learning are active, engaged, interactive, and social, and the Net has only reinforced it through a different media. Interactive learning is not linear; it has to engage students in the construction of knowledge through discovery and moves from teacher-centered to learner-centered, from absorbing material to “navigating” through material and learning how to learn. It is built throughout one’s lifetime, not just while in any level of schooling. Learning has always been about customizing rather than the

“one-size-fits-all” methodology we have been using, as well as learning as fun (not torture) and where the teacher/professor is not the transmitter but a facilitator.

This leads us back to Brown’s article (2000) where he discusses learning. He, along with Tapscott (1998), goes beyond a discussion of learning and education to also discuss family, work, economy, and play; however, we will only consider the comments more directly related to our initiative. Brown considers the Net the new medium; few would argue that. But he goes further describe its process as being more two-way than books, where we can “push and pull.” The one-way approach (books, TV, etc.) pushes information at us; whereas, in using the Net, we can pull what we want from it as well and can take learning in various directions and all at one time. The second aspect, to continue one of Tapscott’s, is that the Web honors multiple intelligences. Literacy has typically been viewed as “text focused.” On the web, we can engage in the abstract, textual, visual, musical, social, and kinesthetic, allowing someone to engage in his/her ideal way of learning and also provide opportunities to build strengths in other ways of learning. Both Brown and Tapscott feel that the Net realizes the opportunity to build multiple intelligences, as Gardner (1983) describes them. A third aspect of the Web is that it “leverages the small efforts of the many with the large efforts of the few” (p. 12). They can all connect on the Web and have greater impact. Brown mentions that we are at the beginning of this transformation, and even five years later that is still probably true, meaning that our classrooms and the student demographics will be transformed even more. Brown and Tapscott both feel that the Web or Net is as fundamental to society as electrification. Brown feels that our challenge is to foster an “entrepreneurial spirit toward creating learning environments—a spirit that will use the unique capabilities of the Web to leverage the natural ways that humans learn” (p. 13). So what does this all mean for digital learners? Brown led a project where he hired 15 year olds as researchers, giving them two jobs – to design the “workscape” of the future that they would want to work in as well as the school or “learningscape” of the future. The designs resulting from the 15 year olds in 2000 “shook them up” (p. 14). They were “multiprocessors,” doing several things at once. There are certainly adults, and Boomer adults, who also fit this mode – able to multi-process, but probably fewer. Many adults are linear processors, learners, and thinkers. But, this “parallel processing” that we speak of for computers is equally happening with those who are digitally literate and who are interactive on the Web. Brown found that the 15 year olds operated with an attention span between 30 seconds and 5 minutes, “paralleling that of top managers, who operate in a world of fast context-switching” (p. 15). This means that short attention spans may not ultimately be considered dysfunctional. Active, fast-paced, high-energy professionals, regardless of age, also fit this profile (e.g., CEOs, scientists, researchers, entrepreneurs, etc.).

Implications

Although these comments would not normally be included in a “demographics” write up, it seems to me that anything we can learn about the college age student helps us better address the teaching and learning context for which we are responsible. It seems that the Millennials are going to be more challenging because they have real expectations of education; their parents are also “more perfectionist and passionate about their kids’ education,” (p. 147) and that includes college. Parents began preparing these students for college from infancy and are cognizant about the importance of homework, extracurricular activities, social learning,

community service, and development of every kind. Mom and Dad are curious about every subject and how it is taught; they scrutinize and provide (sometimes undesired) oversight. To me, this is merely a factor in being held accountable. Having parents involved is a great problem to have rather than the reverse of no involvement. Having students come in with high expectations of their educational experiences is another great problem. However, with these expectations comes real and time-consuming work. We must base teaching and learning on the very best research and practice; we must strive to engage in the Scholarship of Teaching, engage in research on teaching and learning, and share that with our colleagues. In fact, we must engage students with us in the scholarship of teaching.

> Millennials could play an epic role, crafting new myths of lore, doing deeds only dimly imaginable today. The consequences, for good or ill, would be enormous—not just for America, but indeed for the entire world. Thereafter, for the rest of their lives, Millennials would collectively embody the transition into the new modern order, much as the Glorious, Republican, Progressive, and G.I. Generations did in prior centuries. .. Millennials as a Hero Generation…[are they] special, powerful, capable of great collective deeds…So far, Millennials are on track. (Howe & Strauss, 2000, pp. 356-60)

Brown's (2000) findings about the digital students can be explained as dimensional shifts. His 15 year olds in 2000 are just now in college, our classrooms, today. The first is a literacy dimensional shift to more than text and also includes image and screen literacy, the ability to 'read' multimedia texts, and comfort with "new multi-media genres that are nontrivial" (p. 14). Web genres change quickly; the dynamic of change is great. Another literacy is one of "navigation…the ability to be your own personal reference librarian—to know how to navigate through confusing, complex information spaces and feel comfortable doing so. 'Navigation' may well be the main form of literacy for the 21st century" (p. 14). Yet another dimensional shift is about learning, again "moving from authority-based learning to discovery-based learning" and constantly discovering new things as we browse through the "emergent digital 'libraries.'…Web surfing fuses learning and entertainment, creating 'infotainment'" (p.14). To make the move back to discovery-based learning more significant, Brown discusses the third, yet more subtle, shift: forms of reasoning. He describes what reasoning has been, deductive and abstract. Digital learners engage in "bricolage…more than abstract logic. Bricolage, a concept studied by Levi-Strauss more than a generation ago, relates to the concrete. It has to do with abilities to find something – an object, tool, document, or a piece of code – and to use it to build something you deem important. Judgment is inherently critical to becoming an effective digital bricoleur" (p. 14). This is what Web-smart learners become. His final dimensional shift regards a bias towards action. The older generations tend to want to know how to use something before they try things out. They reach for a manual, take a course, and call an expert. Tapscott (1998) mentioned that today's N-Geners do not know what manuals are; they go to the Net. Brown described the Web or Net-Geners who

> want to turn the thing on, get in there, muck around, and see what works. Today's kids get on the Web and link, lurk, and watch how other people are doing things, then try it themselves….tendency toward 'action' brings us back into the same loop in which navigation, discover, and judgment all come into play *in situ*…learning *in situ* with and from each other…learning is situated in action; it becomes as much social as

> cognitive, it is concrete rather than abstract, and it becomes intertwined with judgment and exploration. (p. 14)

Thus, the Web is both an informational and social resource. It has also become a "learning medium where understandings are socially constructed and shared…learning becomes a part of action and knowledge creation" (p. 14). Because what Tapscott (1998) and Brown (2000) have to say about this is so very fundamental to teaching and learning strategies to be used with today's students, it is important to consider more of what Brown's statement about how knowledge is created and shared. The two dimensions of knowledge, according to him, are the explicit – concepts, "know-whats." The tacit is the "know-how," best manifested in work practices and skills. Tacit knowledge "lives in action…comes alive through doing things, in participation with each other in the world…[consequently] tacit knowledge can be distributed among people as shared understanding that emerges from working together" (p. 15). He goes back to Bruner's observation (years ago) that

> we can teach people about a subject matter…its concepts, conceptual frameworks, its facts—and provide them with explicit knowledge of the field…[but] being a physicist involves more than getting all the answers right at end of the chapter…we must also learn the practices of the field, the tacit knowledge in the community of physicist, that has to do with things like what constitutes and 'interesting' question, what proof may be 'good enough' or even 'elegant,' the right interplay between facts and theory-formation. (p. 15)

This is the difference between learning to be a physicist and learning about physics, looking at the explicit and tacit, where the "deep expertise lies" (Brown, 2000, p. 16). This means that we must learn the explicit knowledge of a field, but we must also learn the "practices of its community," now referred to as communities of practice, and the interaction between the knowledge and practices of a field. This requires immersion into a community of practice, being enculturated to understand the ways of the community, the meanings, interpretations, and ways of acting. Knowledge does not lie in individual heads when the tacit (know-how) is factored into the formula. We know much more than the knowledge in our heads when we consider how to use it, its practices. Knowing is realized or comes into being through participation in communities of practice. "Learning to learn" occurs naturally if one is situated in a community of practice, as it has as much to do with understanding the profession within which learning takes place as it does with facts and concepts. The Web presents opportunities for us to "create a new fabric of learning," learning to learn *in situ* – the essence of lifelong learning (p. 16). Brown offers a great example of copier technicians who call each other and reconstruct stories of earlier fixes, connect the stories and figure out together what the problem is. They constructed their narrative, explaining the symptoms, and that resulted in the solution. It was social, constructive in nature, and built on other incidents; it was not the usual logical reasoning. Furthermore, when they returned to the office, they swapped technical stories, problems and solutions, building knowledge and solution banks while drinking coffee waiting for the next calls: learning *in situ* – situational action oriented learning in a community of practice from each other, tacit knowledge along side of explicit knowledge, cognitively and socially constructed. As a result of studying the technicians, they gave them all radios that the techs kept on so that they could hear each problem solving. Then if someone had something to offer to help, they could do it instantaneously because they heard it; they began to interact as it was happening, while in action. It worked extremely

well. This also served well when bringing new technicians in [reduced their learning curve]. However, if some techs were not involved, then they missed out. They went to the Web and created a system to not only record but to validate the accuracy in stories across each other, leading to local heroes in their community of practice. The Web provides a mechanism to capture and continue to interact to build knowledge and learning, expand it, broaden its context, and more. This is just one example; he has others. What is important is that as people build knowledge, they can also construct the meanings and understandings of the knowledge socially. And we can connect with experts around the globe; we are not regionally or locally bound. Cross-pollination of ideas occurs. Jointly, individuals can construct understanding. The Net or Web has transformed learning in our classrooms. Digital learning involves judgment, navigation, discernment, and synthesis, which is critical thinking. Digital learners are both a consumer and producer of learning; they "lurk and learn." Technology, to use Tapscott's (1998) term, has become "transparent." In Brown's (2000) terms, technology has shifted from supporting individual learning to supporting relationships between individuals, a transformation of the learning culture. We at four year colleges and universities are educating the leaders of the near future, guiding their development of ideologies, values, and confidence – far more than just knowledge.

National Perspectives

Student demographics are changing. In 1988, Atwell called for a new momentum for minority participation in higher education at the American Council on Education, noting after visiting western Europe where societies are small and homogeneous that while we are the most diverse nation and that our success is because of our tolerance and inherent pragmatism, "our heterogeneity has been manageable because our size and abundant resources allow us to be expansive. But fundamentally, we are a divided society, the fragments of which have co-existed very well for two centuries despite remarkably little consensus" (p. 1). He noted the obstacles that remained at that time for the new momentum:

- Myth Number One: "We have tried that before and it did not work."
- Myth Number Two: "Minorities must adapt to the institutions rather than the institutions to minorities."
- Myth Number Three: "The key is access; the rest is up to the individual."
- Myth Number Four: "We could do a better job if elementary and secondary schools sent us better prepared students."
- Myth Number Five: "We will never improve Black participation in education until we deal with the deteriorating social structures of the Black community." (pp. 1-10)

Atwell (1988) called for a new metaphor, one that reveres the integrity of each unique group in society, visually changing the image from bisque to a stew. He felt that we were better at adapting to religious and ethnic diversity stemming from Europe than to racial diversity, reminding us of what we did to the Native Americans and our less-willingness to accept Hispanics. He challenged us in many ways, especially our record of success, which also created the malaise. His understanding of the context that has now been realized and described herein, where America has been "browning," has proven resilient and adaptive over the past two centuries, and his belief in our ability to transform has born out. We have changed, but is it enough? Maybe not!

“Colleges and universities are admitting the largest and most diverse student population ever known. The percentage of immigrants in our population is as high, or higher, than the end of the 19th century” (Lovett, 2003, p. 35). CEET, reflecting the national scene, has intentionally increased the number of women and minorities across its four departments. However, where the social compacts of the 1960s and 70s somewhat corrected the inequalities between the majority and minorities, there are now other inequities to address (e.g. class, culture, and age). Since then the college has worked hard to create support systems and mentoring programs and has modified class schedules and made campuses more accessible, but today’s issues have become more complex. The standards have to change if we are to serve a growing number of students who are

> 25 and older…partially or entirely financially independent…are combining college attendance with other pursuits…attend more than one institution before they graduate…and want opportunities to demonstrate what they already know and can do regardless of where they acquired that knowledge. They need to earn degrees based not on course grades but on comprehensive assessments according to criteria that faculty experts are entirely capable of devising and implementing. (Lovett, 2003, p.35)

We have a large international student body within the college, and more students are working part or full time, have families of their own, and/or have transferred, reflecting our strong community college articulation agreements, dual enrollment, and positive attitude towards transfer students. Lovett (2003) speaks of a “new majority” of students who could then worry less about attending a prestigious institution, often exclusive and expensive, or the life consequences of not attending such an institution and focus more on demonstrated competencies. This would meet the needs of the majority of today’s college students: college degrees based upon an assessment of competencies – a results-oriented approach.

Lovett (2003) goes on to discuss how wealth distribution and college costs are affecting access to higher education. A changing pattern of wealth accumulation, distribution, and control in the US as well as wealth inequalities (the income gap) have the potential to become an educational gap, which again perpetuates the income gap. The issues facing higher education are deeper than costs have gone up and students cannot pay. The issues go to the heart of the arguments presented later about the role of universities in society: the role and responsibilities of faculties and what students are supposed to experience. “For instance, the leaders of public institutions might commit openly and unequivocally to refocusing financial aid on low- and middle-income applicants instead of using it for merit scholarships in hopes of climbing another rung or two up the ladder of academic prestige,” e.g. Carnegie classification (p. 36). Lovett discusses “Interdisciplinarity, Globalization, and Academic Structures…[stating that] on most campuses the necessary transformation of academic programs and organization practices to make them more capable of supporting interdisciplinary teaching and research is still in its infancy….[W]e [are] shackled by traditions and structures” (p. 37). The obstacles that prevent us from engaging in interdisciplinary scholarship also prevent us from shaping the nation’s domestic agenda and reclaiming a global leadership role.

This initiative is an attempt to address some of the underpinning issues Lovett (2003) presents. Brown, Santiago, and Lopez (2003) discuss Latinos in higher education. Latinos are

the fastest growing ethnic group in the nation, with almost 13% of the population going on to college. About 10% (over 1.3 million) of U.S. Hispanics now have a college education, a dramatic increase over the past 10 years. The educational achievement of Latinos has become very important to higher education, as it will impact the economic and civic health of the country. However, it is important to understand the challenges. Most Latinos in higher education are first-generation college students, low-income, less academically prepared than their peers, and attend community colleges first. Latinos are concentrated in a few states and thus at a few institutions of higher education. A great number of Latinos in higher education are nontraditional students, part-time, older, working, and with family responsibilities. So how do we ensure their success? Through advocacy – "As first-generation college-goers, many Latino youth must rely on formal sources of information to tell them how to prepare for and participate in higher education" (p. 42). With little formal education and/or English speaking ability, their families are limited in their ability to help them toward higher education. Often this is misperceived as Latino families not valuing education, when in fact just the opposite is true. It is just that Latinos need to know how to navigate the system and access critical information about higher education. Many Latinos do not know how to overcome the financial issues, nor do they know much about financial aid and thus assume the costs are beyond their ability to bear. They need assistance with the admission processes and especially need to understand articulation between the community colleges and the universities.

Many of these challenges exist for non-Latino or majority students as well; however, they can often navigate the application, financial aid, and other processes more successfully. Most importantly, "the underlying principle of institutional capacity building as a means of enhancing learning environments for all students is the basis for many federally funded programs" and is our responsibility (Brown et al., 2003, p. 44). What does that mean in terms of this particular initiative? Good teaching; integrated assessment; cooperative and collaborative learning; learning opportunities that use a variety of intelligences and learning styles; engaging students in active, problem-based, and performance-based learning; and more are part of the formula for all students' success, and especially minorities and women. This is how we can ensure the academic success of most, if not all students; this will also go far to ensure persistence, retaining them until graduation.

A point I have made repeatedly to professional development groups is that the teaching and learning strategies we are asking professors and K-12 teachers to learn about and use improve the possibility of success for minorities and women students; however, they are equally important for all students. How often has it been true, even in honors classes or classes for the talented, that we do not take those bright minds where we could? In other words, we should be using teaching and learning strategies that move those students into higher level learning activities. That is an equal responsibility for all students regardless of who they are and what their ability level is. If they have been accepted into our institution and end up in our classes, it is our absolute responsibility to challenge, to stretch, and to extend their knowledge and abilities. The point I want to make is that the good teaching and learning strategies, and those of focus in our initiative, are beneficial to all students and will result in increased knowledge and ability gain. (See Literature sections throughout) However, because sometimes minorities and women in engineering and technology (and other fields)

do not perform or persist as well as majority students, these strategies are especially successful with these groups.

Brown (2003) makes a similar point about institutional perspective relating to this point; often "it is seen in the institutional culture, where creating a successful environment for Latino students is understood as a learning experience for all instead of a burden to be borne by some…where leaders make sure that efforts to retain students are not isolated but systemic…hiring of new colleagues who value the student population"(p. 44). My point reflects this philosophy – good teaching strategies are successful with all students. An especially good strategy is student learning communities. Our initiative described here first begins with trying to build and develop a faculty learning community that will in time move towards developing formal student learning communities more often throughout student learning across courses and programs. (That, however, is yet to come; we are building the foundation first). One of Brown's recommendations supports my operational premise about teaching and learning strategies. "Promote the wider use of proven strategies for helping Latino students achieve at high levels, and develop better strategies based on best practices" (p. 46).

Student Swirling

Traditional students are no longer the tradition, thus student demographics have great implications for teaching and learning. College for students is becoming a greater struggle for the middle class and continues to be difficult for the lower economic class. Although we have always had a large group of students who work their way through college, the number has grown. The number of transfer students from two-year to four-year colleges is increasing, and students may attend several higher institutions simultaneously throughout the completion of their degree – spiraling. The term "student swirl" (along with "double dipping") was coined by Santos and Wright in 1990 to mean enrolled concurrently in two institutions and characterized by the back and forth mode of attending courses across both institutions. However, the swirl does not only happen in two year institutions; it also happens in four year institutions (Adeleman, 1999; McCormick, 1997 as cited in Borden, 2004). These authors and others also began to focus on what is know as "reverse transfer," transfer from four-year to two-year institutions, "the return trip" (p. 12). McCormick (2003) differentiated the types of swirl (as cited in Borden):

1. trial enrollment (experimenting with the possibility of transfer by taking a few courses)
2. special program enrollment (taking advantage of unique courses and programs offered at other institutions)
3. supplemental enrollment (accelerating progress by taking additional courses—during summer, for example—at another institution)
4. rebounding enrollment (alternating enrollment at two institutions)
5. concurrent enrollment (that is, double dipping)
6. consolidated enrollment (taking a collection of courses at various institutions to complete one institution's degree program)
7. serial transfer (one or more intermediate transfers on the way to a final destination)
8. independent enrollment (taking courses unrelated to the degree program, for personal or professional interest, at other institutions).

There is also an "intra-institutional swirl" in which students enroll in travel abroad, co-op education, or exchange programs, interruptions in a program sequence that can also add time to graduation. Although well known by most administrators, I believe relatively few faculty members actually realize this. The implications can be rather significant for students in our classes. Students I know who fit one or more of the above experiences have come to me for advice on scheduling, to discuss credit for courses across institutions in which segments of a course or whole course content is similar or the same. Partial content credit issues can be complex and can impact their expectations of our courses or what they actually do in our courses. This "swirling" situation needs to be understood by our faculties. We benefit if we know where our students are coming from and what their backgrounds include. Therefore, the participants in this initiative discussed the importance of exploring students' files for transcripts during our professional development program. The discussion was not directly tied to swirling, but for the purpose of better understanding the students, their competency levels, and more. For us, very important competencies are expected in mathematics, sciences, communication skills, and the prerequisite or sequential aspects of a program, etc. Understanding student "swirling" is also directly important; however, the argument is that professors are short on time and reviewing student transcripts does take a good deal of time, especially if the courses enroll large numbers and swirling does not just occur for general education aspects of the degree programs but involves courses in the majors as well.

Although about general education, the contributors to *Students in the Balance: General Education in the Research University (2002)* make points about instructors teaching general education courses rather than professors, possibly sending a message that the courses are less important (Keat & Wright). These contributors go on to challenge those general education instructors on their responsibility for student success and on the failure of students to understand the curricular goals of a research university, but they fail to discuss the goals of general education and how their particular courses can help students achieve those goals. The importance of syllabi, web pages, lectures, and assignments do not place [make sense of] any one course in the overall curricular structure for the students. Many instructors or professors, themselves, do not understand the goals of the general education program, for it is acknowledged and supported as program rather than a series of preparatory courses in most progressive universities today. When considering the lack of interest or motivation for faculty members, it is important to remember that faculty members are truly required to specialize in their fields if they are to be awarded tenure and promotion, thus they are not usually focused on general education. Faculty members have few incentives to want to teach general education courses. Thus teaching general education has to be addressed by the administration of all departments to make it important. After all, general education prepares students for advanced courses, and if we expect them to come prepared, it is important that the students tie the knowledge and skills learned in those courses to the courses in the majors. For us, this discussion about general education has importance. Our faculty development program included an analysis process to itemize the general education knowledge and skills embedded within the major knowledge content, showing the relationship between general education, accreditation criteria or standards, and the student learning objectives and course content. This linking has been received very well by the program leaders' students, thus those in the program are trying a new syllabus structure and content in their revised courses.

When specifically considering women and men who have chosen engineering, possibly with implications for engineering technology (accredited by ABET and somewhat for the field identified as technology, accredited by NAIT), we reviewed the collaborative study by the U.S. Department of Education and the National Science Foundation (1998). The study's focus was the paths students take through higher education, with engineering as the case, because it brings all the variables affecting choice, persistence, and migration into play and is a field where there has been an historically severe gender imbalance. The study used student transcripts from 1982-1993 and the strategy of "the student as the story-maker," a somewhat different than traditional approach. Selected findings regarding the gender and classroom aspects only are that

- Women who intended to major in engineering enjoyed the highest degree of parental support for bachelor's degree attainment among all women – or men – who intended to major in any field.
- Women and men earn similar grades in engineering courses, and the women who leave engineering have higher grades than the men who leave.
- Women who leave engineering do not leave because of poor academic performance, though they do evidence a higher degree of academic dissatisfaction. (p. xi)

When experiencing engineering education, classrooms, credit loads, and grades, the U.S. Department of Education and the National Science Foundation (1998) acknowledged that

> we have not been tracking students in higher education very well in terms of initial field choice and change of major as they search for academic identity; [this] traffic…moves at a high rate; provosts and deans worry about this because it affects their ability to plan; and some fields worry about attrition and migration because they have historically exhibited equity problems. (p. xii)

Thus, the focus is on engineering because the literature indicates its enrollments are volatile, attrition is reported as very high, and it is considered a highly gender-segmented field. "…women who begin the study of engineering in college are less likely to complete a degree in engineering than men, thus exacerbating the segmentation" that begins in high school where students acquire "curricular momentum" and where a "higher proportion of women than men have that curricular momentum but do not choose to explore even the threshold of the engineering path in college" (p. 81). Those writing the monograph concluded after studying the works of others (e.g. Becher, 1989; Chelapati, 1990; Constantinople et al., 1988; Davis et al., 1995; Felder et al., 1995; Grandy, 1994; Henes et al., 1995; Serex, 1997; Seymour & Hewitt, 1997) that

- Students who complete engineering degrees are no more dissatisfied with their college experience than non-engineering students (p. 82).
- Student choice is an evolving phenomenon, and it is not very accurate to talk about "attrition" in any field until a student actually starts to major in it, then leaves for something else. Women and men who leave engineering are more likely take their curricular momentum into computer science and the physical sciences than other majors (and in our direct case, Engineering Technology or Technology); and women who leave the engineering path are more likely to complete bachelor's degrees than are men. (pp. 83-84)
- Freshmen, regardless of disciplines, possess a similar range of concepts and are equally as likely to attribute the broad scientifically based problems to both social

behavior and technological developments. Engineering students, however, were more confident in technology as a solution…one of the reasons they are majoring in engineering! (p.85)

- There are further implications [serious challenges] of a different vision of recruitment for the undergraduate curriculum because engineering students face a daunting set of requirements in terms of credit-load. Engineering education faces a tension between superficial coverage ("a sense") and the additional credits and time that come with depth. They suggest changing the degree for today's times and needs. (p. 86)
- The strategy of lower-division science courses, Tobias (1990 as cited in NSF, 1998) argues, should be to cultivate not weed (though "weed out" may not be the most felicitous of terms to describe what happens), and these courses are still part and parcel of new program combinations. No discipline can maintain enrollment shares with a weed-out system, and yet each discipline has a culture that naturally diverts some students onto other paths.
- Yes, we can improve the way science and engineering are taught, particularly in large institutions, but let us not pretend that these are the only domains in which such an effort is necessary.
- Men have been a distinct and declining minority in undergraduate education (enrollees and degree recipients) for more than a decade. (p. 87)

Kuh (2003) reports on the *National Survey of Student Engagement* (NSSE) results. This survey is an effort to improve the assessment of the quality of undergraduate education by looking closely at the level of student engagement during the academic career. The survey focuses specifically on educational activities related to learning and personal development. The NSSE Benchmarks are (1) Level of Academic Challenge; (2) Active and Collaborative Learning; (3) Student-Faculty Interaction; (4) Enriching Educational Experiences; and (5) Supportive Campus Environment. Three years of data on 600 four-year colleges and 285,000 first year and senior students reveal, among many other things, that the following are more "engaged":

- Women
- Full time students
- Students who live on campus
- Native students (those who start and graduate from the same school)
- Learning community students
- Students with diversity experiences (p. 26)

For the most part, Kuh (2003) explains that this is to be expected with full time students who live on campus, commenting that these students would probably have fewer obligations, family responsibilities, and off-campus work that would keep them from participating in or accessing opportunities and resources. He did not comment on women in particular as to why they were more engaged; however, he did go further to say students of color "experience college differently than white students" but noted that they "engage" at a comparable level (p. 26). African-American students, however, report lower grades (with white students getting the highest grades), even though the GPA is positively related as the same for all benchmark scores and educational practices.

On the question: *Are students putting forth enough academic effort*, Kuh (2003) discusses that life situations of both traditional-age and returning college students are more complicated. Life exigencies such as full time work and care for dependents seem to limit the amount of time that can be spent on studies. He especially noted that “Even the majority of traditional-aged, full-time students are working by the time they are seniors” (p. 27). Students, however, expect to be more engaged than they are (e.g. read more, write more, and become involved in cultural activities). They expect to and actually do study more than in high school, but faculty feel more is needed. Of the academe’s expectation “two for one” (study two hours for each hour of class), students only spend about half of that. Students are coming to class unprepared, saying that there is little emphasis on studying and spending time on academic work. Thus when students are not engaged and spend less time on studies, they do not perform well. Kuh mentions the problem partially begins before college when students are not engaged in high school but graduate with A’s, thus implying that higher grades are received for less work or lower performance.

Kuh (2003) poses the question *“Are we willing to make the effort that such practices demand of us?”* Students rarely exceed their own expectations about academic work. Conversely, students will go beyond what they think they can do if conditions exist where their teachers expect, challenge, and support them to do so. When we demand that they do something, they will do it. When prompt feedback is provided, they learn more. The more students are asked to do, the more we, as professors, have to do to prepare the activities and give feedback to students. He says there is a direct relationship between what we do and student response – the more we do, the more likely students will visit during office hours to talk about the feedback. This sometimes creates a dilemma in faculty time allocation to multiple priorities. Often, a “disengagement compact” occurs in which “I’ll leave you alone if you leave me alone. I won’t make you work too hard (read a lot, write a lot) so I won’t have to grade as many papers or explain why you are not performing well” (p. 28). Kuh feels the evidence of the existence of the pact is that many students get decent grades, B’s and sometimes better, for a low level of effort. He feels this is a breakdown of shared responsibility where faculty allow students to get by with less than maximal effort and where students are not taking advantage of available resources. If college is to be transforming, there is no substitute for “time on task”; it is a “once-in-a-lifetime opportunity to challenge students to examine previous ways of knowing, thinking, and behaving” (p. 28). If students do not engage enough to develop the habits of mind and heart of an educated person, then that opportunity is missed.

When considering the question *“Is the active and collaborative learning movement inadvertently undercutting academic effort?”* – it seems that faculty members are responding by structuring active and collaborative learning activities based upon reports from students. But there is no information that can judge the quality of these learning experiences. The numbers only reflect the frequency students report being involved in these types of experiences. Some anecdotal reports indicated that students may not prepare as much for classes in which in-class group work occurs, relying on their group members to make it all happen. Well-designed and executed collaborative group work that is active would prevent this by building in individual and group accountability, etc.

"How much faculty interaction is enough" is not an easy question to answer; the key is substantive contact. Kuh (2003) reports that casual contact does little to increase learning gains or effort. If technology is used effectively, it seems that "student success can be achieved in class without increased student-faculty contact" (p. 29), but it requires faculty to be more intentional and available on an as needed basis. Sometimes occasional contact is enough. The nature and frequency of contact matter, but there are six purposes for contact between students and faculty: (1) career planning; (2) working on a committee, project; (3) or doing research together. The first two might only need to occur once or twice per semester. However, working on research with a faculty member could alter a student's life. The next three are more critical in that they should occur more often: (4) prompt feedback on performance; (5) discussing grades and assignments; and (6) discussing ideas outside of class.

Kuh (2003) reports that transfer students are usually less engaged. The study reveals that at some universities, the number of transfer students exceeds 70 percent (the CEET percentage is approximately 40%). The NSSE concluded that "transfers generally find their institutions as academically challenging as their non-transfer peers do,…report[ing] comparable grades, and are more likely to be prepared for class than non-transfer students" (p. 32). This could be that they are older and commuting, and more than 50% are first-generation students. There may be many other reasons for less engagement (e.g. new institution, different culture, and transfers do not have specially designed socializing experiences such as the ones for incoming freshmen). Thus, this is a challenge leading to questions about articulation, performance indicators, and more. Less engagement by transfers does not seem to be a function of attending a certain type of institution, meaning transfers from community colleges to university versus four year to four year college transfers. Less engagement prevails regardless. The two-year college sector is growing, and more students are attending multiple institutions to achieve a baccalaureate degree. We can expect continued increases; therefore, it is important to find ways to more fully engage transfer students through more effective educational practices.

As for *"Does experience with diversity matter to student engagement?"* – knowing how to effectively work with diverse individuals is critical. Students reporting more experience with diversity are more involved in other effective educational practices, e.g. active and collaborative learning. There is still a need for schools to look for ways to ensure that students explore human differences in positive and purposeful ways, for "more than a fifth of all seniors think that their schools give little emphasis to encouraging contact between students from different economic, social, and racial [ethnic] backgrounds" (p. 34).

Light and Cox (2001) spent 10 years systematically researching and exploring how to facilitate the best possible undergraduate experience. They present a synthesis of the work formed around two primary questions: "first, what choices can students themselves make to get the most out of college?" and "second, what are effective ways for faculty members and campus leaders to translate good intentions into practice?" (p. 3). All findings come directly from intense student interviews with more than 1600 undergraduates, some more than once. One of the most important insights is that learning outside the classroom is vital, for example in residential settings or through extracurricular activities; students reported that outside

classroom events were where they experienced the most profound changes. Another finding, important to our initiative, is that students reported

> they learn significantly more in courses that are highly structured, with relative quizzes and short assignments….Crucial to this preference is getting quick feedback from the professor – ideally with an opportunity to revise and make changes before receiving a final grade. In contrast, students are frustrated and disappointed with classes that require only a final paper. How can we ever improve our work, they ask, when the only feedback comes after a course is over and when no revision is invited?" (p. 9)

Yet another surprise was about homework and the controversy regarding "collaboration," historically considered cheating. Today professors encourage students to collaborate or work together, often creating small study groups where students work together outside of class. To us this is the foundation for student learning communities. Sometimes the academic assignments are so challenging or complex that the only way to get through them is to collaborate, and many students report that such homework assignments increase their learning and their engagement in class (Light & Cox, 2001, p. 9). This directly supports our initiative but is still a new format for learning on campuses. Furthermore, students particularly value a faculty "mentored internship – not done for academic credit" in which the student engages in a project under faculty supervision, using their own plan (not the faculty member's) on a topic they care about (p. 9).

Light and Cox (2001) go on to report that although students are perceived as not interested in the sciences and engineering and the faculty members are interested in research, this is not really true. More male and female students are strongly interested in the fields than any other group of courses and they would not want to work with faculty not actively pursuing their own research. A student said

> Of course, I want a faculty advisor who is a good teacher, who is kind, who is willing to spend time supervising me, who is available, patient, and who explains things clearly. But if to get that level of perfection I had to work with a faculty member who was not actively doing research, I am not sure why I would seek such a person to supervise me. My goal is not just to learn biology. It is much more than that, especially by junior and senior year. It is to learn how to really do biology. And it seems pretty clear to me that to do biology I need to learn from someone who is actually doing it too. (p. 71)

Going further, Light and Cox (2001) present another perception that many undergraduates avoid the physical sciences because they feel they cannot do the work or that they avoid science classes because the workload is much heavier; this is also wrong. They find that about 30% express these concerns about their preparation to do well in such courses. The other 70% choose other disciplines because of other reasons. The perception of heavier work loads is partially correct and incorrect; natural sciences do have heavy loads but are usually tied with language classes in workload. Their work load is rated just slightly higher than those for the humanities and social sciences, so this does not bear out as well. Finally, a perception that there is more grade competition among students in the sciences is clearly correct. In science classes, the competition for grades is well above other disciplines. Most important to our initiative is that the students said that in small classes they can get to know

the professor better, one on one; and, the professor can use teaching techniques that are more difficult to use in larger classes (e.g. organizing the class around a controversy, presenting the opportunity to develop arguments and argument skills). Light and Cox make recommendations for faculty consideration about workload and grade competition, study groups, increasing interaction, and how to attract and keep more students. Most of their suggestions were addressed in our professional development on teaching and learning. They confirm our directions.

Light and Cox (2001) also learned that

> how students study and do their homework is a far stronger predictor of engagement and learning than particular details of their instructor's teaching style; thus, the design of homework really matters…specifically, those students who study outside of class in small groups of four to six…benefit enormously; they do homework independently before they meet. The meetings are organized around discussions of homework. And as a result of their study group discussion, they are far more engaged and far better prepared, and they learn significantly more. (p. 52)

Also an overwhelming number of interviewed students felt that "the impact of racial and ethnic diversity on their college experience is strong…[and] an overwhelming majority of undergraduates characterize its effects as highly positive," but they noted learning from others who are different does not always happen naturally, thus campus atmosphere and living arrangements are crucial…also noting "only when certain preconditions are met does 'the good stuff' actually happen…that those preconditions are factors that campus leaders can do something about…shap[ing] an environment in which diversity strengthens learning." (Light & Cox, 2001, p. 9).

These concepts go to the heart of what we are trying to change as a result of our initiative. If both individual and group accountability are structured into group work and the assignments have integrity and are based on sound criteria with well designed rubrics, work outside the classroom can be high quality. However, this philosophy and the skill set and time that are required to begin to learn to use highly structured, but open ended and accountable, group work take time to develop, at least at first.

Another result in Light and Cox's (2001) study was about writing. Most surprisingly is students feel very strongly about good writing and are greatly concerned about their writing and want to develop good writing skills. Many professors today do not require writing assignments, as it takes extensive time to grade them. Therefore, students do not get the opportunity to practice and improve across their courses. We have professors who feel that once students reach their major they should not be writing instructors and should only grade for content, although some, of course, understand that we are both. Light and Cox describe students who improve the most as those who worked on writing very intensely with a professor or writing teacher or small group of fellow students and that the longer they worked on it, the greater the improvement. This professor believes in many written assignments with a mix of types of written assignments and requires the Writing Center visits for developing the ideas and then for critiquing the writing itself. When my students get their written assignments back, there are several colors of comments; some students commented that they could not believe the amount of work evident in my feedback. They let me know

they were impressed that I had worked that hard on their work. It makes sense, however, because the more writing, the more group work, and the more time students have to spend on their courses, the more their level of engagement increased. Although no single course, even with many writing assignments, can correct poor writing habits, several courses that emphasize writing can at least make students aware of their writing issues so they know when to have it edited. Also when students have to write, they are really engaged. There is no way to escape being engaged in course content and/or the class itself if exchanges are executed through jigsaw, etc. We have introduced that to the professors involved in our initiative, and I believe some have taken new steps in regard to writing. However, it is very important to note that the structure and meaning of the written assignments is extremely important. Just as for group work, there has to be serious purpose; specific criteria for content, argument, and mechanics; a good rubric for scoring; etc. for it to be meaningful and not just busy work. Some of us use the "one minute paper" that Light and Cox mention, and some even before the idea was published as the "one minute paper" by Felder (1988) and Johnson, Johnson, and Smith (1998). It is a good teaching and learning strategy and has varied methods of use.

Finally, Light and Cox (2001) go on to summarize several other findings: students who get the most out of college include activities with faculty members or several other students to accomplish substantive academic work. They "hungered for specific suggestions about how to improve it" (p. 11). Students went on to describe particular activities outside the classroom as profoundly affecting their academic performance (e.g., time management activities, small group work, and study techniques). Students discuss "foreign language" or other such requirements, literatures, with enthusiasm; many giving them the highest ratings – it is all in how they are taught and organized. Light and Cox conclude, from analyzing 1600 student interview responses, that students give a lot of thought to what works well for them (in an academic environment) and can offer their insights to learn how to improve it. The responses were fairly consistent whether with Harvard or other national, regional, small, large, private, or public institutions.

Light and Cox's (2001) results directly support the Scholarship of Teaching arguments presented by Boyer (1990) and others. The results also support the intentions of our initiative and how to engage students, regardless of their demographics. Our initiative begins with trying to build and develop a faculty learning community that will in time move toward developing formal student learning communities throughout student learning across courses and programs. (That, however, is yet to come; we are building the foundation first.) Therefore, we offer thoughts and some literature on learning communities. Additional information can be found in the literature review.

Need for Student Learning Communities (LC)

Although our primary focus for this initiative is to create and sustain faculty learning communities, we hope to evolve further to where the work with our professors will result in creating formal student learning communities. Understanding our students is fundamental to that purpose. Therefore, the demographic information can go far to assist our faculty members in their desire to better understand their students and to create a learning environment that will stimulate and motivate them to achieve to their potential.

Schroeder (1993) found that more than half of today's students perform best in a learning situation characterized by "direct, concrete experience, moderate-to-high degrees of structure, and a linear approach to learning" (as cited in Levine & Cureton, 1998, p. 25). They value the practical and the immediate, and the focus of their perception is primarily on the physical world. However, 75% of faculty members "prefer the global to the particular, are stimulated by the realm of concepts, ideas, and abstractions and assume that students, like themselves, need a high degree of autonomy in their work" (p. 25). Students prefer the concrete subjects and active methodology of learning. However, students are highly satisfied with higher education and would not change it much, even though they do not believe it guarantees them a good job. However, they understand that they cannot get one without it. It is discrepancies such as these that influence this initiative.

For example, in the undergraduate courses taught by me over the years and, more recently, the senior design capstone course, my reputation has been known as "the witch [professor] from hell." And when students evaluate the course, my experience (although only once and a long time ago) was a reduced score on the course evaluations because of the required level of active learning strategies that students had not experienced before my course. To explain this, and without ego I hope, in the undergraduate senior capstone course, students come into my course(s) having heard about the demanding nature of the requirements and activities, meaning the expectations for both individual and team assignments, formal teaming, extra meeting times, and very specific outcomes. It was interesting to note, however, that within three to four weeks (or sooner), they began to see relevance, validation, and the important connections to both the theoretical and conceptual content that is so very dear to professors, but beyond that, they began to see its connection to the external world as a result of "how" they learn this content. They began to realize the importance of the "formal" team requirements as well as understand the individual accountability built into the course by the individual assignments required to prepare them for the team experience. In addition, they began to realize, respect, and appreciate my direct focus and began to understand why we did not make some of the changes a few of them may have requested to make the course fit better into their overall lives.

When I require that they function in true teams, this means they are formally trained to be teams - not just assigned to working groups. They have to fully execute a technical project according to very specific criteria and outcomes for the team, project, course content, etc. If their teams had difficulty (and we tried to ensure that every team had difficulty), then some of them, although very rarely, did not see beyond the immersion experience to what they had learned (even though we thoroughly explain that each team must experience difficulties), as that was a requirement to work though the team's learning content and process. For others who might try these teaching and learning strategies, team members' interpersonal difficulties may translate into a reduced overall course evaluation score. However, simultaneously, in their formal and very analytical team presentations, they all actually raved positively about what they learned, illuminating with examples, content, products, and processes – all a professor could ever hope for from students. The point here is that professors must be capable of risking their end of course evaluation "score" if they are fundamentally and primarily concerned with the integrity and rigor of the course, teaching, and student learning experiences. This is a great leap for many.

Although we felt that this initiative had to first begin with developing a faculty learning community, do not assume that there are no student learning communities throughout our departments, courses, or curricula. Although few, some professors have very active informal student learning communities engaged in complex problem solving through real world or simulated problems/projects where student groups (not really teams or formal) are structured to work together. It was our goal to create a formal faculty learning community, and by modeling that design, process, and procedures, they would see the importance of the "formality" of structuring student teams, ultimately learning communities. If formal, the outcomes could better be required and measured. Professors must determine if they are measuring only discipline-specific knowledge and skill gain and/or if they are going to measure student performance in teams and the community as part of the course knowledge and skills. This determination is critical, as it goes beyond what is perceived as "typical" disciplinary content. However, team experience and performance is today one of the accreditation program outcomes, so it is legitimate as "course knowledge and skills." If it is to be included and measured, then there must be established team and community performance criteria for students to understand the interactive processes and dynamics and differences between working individually versus in teams and as teams within a larger community of teams. When knowledge and skill learning is critical to the success of the student individually, then individual and team/community accountability must be ensured through the teaching and learning process. Also if individual success is measured by his/her cooperation and collaboration with other team members, it also must be established in the performance criteria. Extending the point of individual versus group "accountability," it is important for the professor to determine what is acceptable performance or evidence of learning disciplinary content. Does each student need to provide evidence of learning or is it acceptable for the group to provide a collective evidence of learning? This is mentioned by Johnson, Johnson, and Smith (1998) as building in "individual accountability" into group work and is critical when structuring collaboration or cooperative learning for teams and/or student learning communities. It was also critical for us in structuring the learning experiences for the faculty learning community.

Although a somewhat different aspect regarding student learning communities, in one of my graduate courses long ago, I began the course by initiating the students into a new process, one where they could help choose the course content. As we all know, we choose course content based on what we know and/or identify as important within the whole body(ies) of knowledge across the field or related fields. So there is a great deal of choice and possibilities available to professors regarding disciplinary knowledge, skills, and information, unless one is the sort to choose a text and merely follow the text (UGH!). My goal was to engage the students in more of a learning community, not as formal as the one described above, but where learning could occur using a more open process and where we could address some critical knowledge that was desired individually and collectively. When presenting this opportunity to my group of students (a typical graduate range of younger to older, full time working engineers and managers mixed with full time grads), they became angry! They did not want the choice; they wanted me to dictate. I refused, and we got through it, ending positively. But introducing the more collaborative approach between professor and student caused a rather tense conflict as students were expecting me to dictate. That was the model they were used to from others, and they initially perceived the effort as too demanding. One or two questioned me about whether I was doing my job. Once again, this is a situation

where you may know that you are using the best teaching and learning strategy, so you must follow through even though your end of course evaluations may be lower initially. Once the process was introduced, students came in with topics in hand because they needed it for work or had read about it. The point, again, is that the professor must be willing to try different strategies, models, and procedures, fully understanding that at least once their evaluations may change, not much but somewhat lower. That process resulted in a modified version. We arrived at a combined strategy of my choices and theirs and created more of a learning community, where there was an open forum and we were learning more, learning from each other, and the content was extremely relevant. In fact, I realized that more knowledge was being covered, more interactively. With experienced graduate students, there is a wealth of experience, new information, and validation to draw upon. Beside other validation learning strategies within the course learning processes, the professors can validate content as relevant from the communities of practice, business, and industry for the inexperienced or younger students.

When Guteck (as cited in André and Frost, 1996) discusses learning, she writes of the same question that has often come to me about course content and process "Why are you changing your courses so often?" or from the outside world "How can you stand to teach the same courses over again?" My response was almost identical to hers: "They are not the same; there is new content, different methods, and new issues each time I teach them. They have to change! It is not boring" – but the other part of my answer that I do not always express is that I have learned so much during and between each time of teaching each course. My research, travel, reading, conferences, colleagues, and very often my students, especially those who work, teach me so much in so many ways and/or through their questions or presentation of problems stimulate me to study something. It may not be always new knowledge, but the context within which it is applied or employed to solve a problem becomes modified. One's existing knowledge is "a gift that keeps on giving," in that each time it is used, questioned, or presented in a different context that knowledge, information, or skill extends, deepens, or becomes useful in a different context, becoming greater and different than it was and evolving into new knowledge. IF we are learning individuals and not merely the "learned," there is hope for academics to build exemplary learning communities – those that should be an especially desired goal are the faculty/student learning communities.

However, this is not the greater majority of our learning scenarios. Because we want to lead more faculty toward student learning communities and circles, and ultimately to faculty/student learning communities, we are studying the work that has been done to date. Anderson et al. (2003) led an initiative at North Carolina State University with other research universities to develop student learning communities and faculty pedagogy. For us, this means that there was a faculty learning community that engaged in learning about pedagogy, one of which is collaborative learning through student LCs, and then in the design and development of student learning communities, not always through intact classes. As with FIGS (freshman interest groups), a higher education interdisciplinary theme-based learning culture across courses and professors, learning communities can be structured as class based for students, but that is not a requirement. Faculty learning communities can be interdisciplinary as well. Those working together at N.C. State determined four broad learning outcomes for students: (1) critical thinking; (2) habits of independent inquiry; (3) responsibility for one's own learning and intellectual growth and development; and (4)

student learning, promoted through the active investigation of complex questions and problems (p. 27). These seemed to be appropriate for our faculty learning community as well and then, in turn, for their consideration of student learning communities. Anderson et al. note that LCs are widespread because they can be used or adapted flexibly, "a vision of faculty and students – and sometimes administrators, staff, and the larger community – working collaboratively toward shared academic goals in environments in which competition is de-emphasized….faculty and students alike have both opportunity and responsibility to learn from and help each other" (Anderson et al., p. 1; Angelo 1997, p. 3). They worked together to restructure the curriculum into interdisciplinary endeavors around themes, enrolling a cohort of students, similar to FIGS, but as faculty/student LCs.

When discussing the Faculty Pedagogy Workshops, Anderson et al. (2003) stress that a common language is needed and the focus should be

> to develop classroom practices that encourage and help students to raise, sharpen, and follow through on their own questions, to respond to questions posed by the faculty member by asking further questions and seeking answers to them, and to develop a habitual sense of inquiry that would transcend the boundaries of the course. (p. 27)

The faculty participated in symposia across four professional development tracks: 1) Classroom Teaching Practices and Inquiry Guided Learning (IGL); 2) Technology and IGL; 3) Assessing the Effects of IGL on Students and Faculty; and 4) Other undergraduate initiatives. They identified their changed foci from three sources: "1) what our teachers told us they needed and wanted to know; 2) assessment of our programs; and 3) trends and literature on faculty development and best practices in undergraduate education" (p. 34). This also reflects our strategy. They used a summer workshop strategy; we are including time during the school year and summer as well. We are following with formal research experimentation in the classroom in our move towards teaching as scholarship. Anderson et al. (2003) establish that student learning communities are most common in research universities but make no judgment about more comprehensive universities. A long standing and traditional example of student learning communities is the law school model where students form and belong to study groups. The peer support, reinforcement, and methods are used to distribute responsibilities individually for group study and learning continues to be practiced and work well for students.

Although not a student group, my own doctoral dissertation situation somewhat reflects this type of opportunity in which a faculty committee and I engaged as a learning circle/community. At Ohio State University, I took a high level graduate elective in reading comprehension, and in the process met one of the most outstanding researchers in the multi-field of reading, comprehension, information processing, etc. Because of his teaching strategies and student learning processes, I was motivated to want to learn more from him and was stimulated to involve myself in learning at a deeper level with an interdisciplinary focus. My field immersed me in technical knowledge; his immersed me in the fields fundamental to learning, those of processing and retaining information. This led me to decide that I wanted to focus my dissertation on student learning and technical information processing. Coming from a technical field, I was not prepared for such research, and although my committee members were certainly experts about learning, they were not about information processing, memory, etc. When I discussed this with my advisor, he said that the

committee did not have the complete knowledge set to direct such a dissertation, BUT! if I could get the education professor to be the director, my committee members would be willing to learn with me. This was rather unusual.

In following through, I went to the education professor; he scratched his head and said to me, “Do you realize how many fields of literature you will have to immerse yourself in to even begin to design a simple study in the information processing of knowledge?” I said, “No.” He informed me I would have to read material on artificial intelligence, linguistics, information processing, learning, and more – at least of year of reading. I was truly interested and respected him so highly – not to mention that his method of teaching had created such a spark or stimulus and motivated me to want to know more – he agreed to try. At the time, however, I did not realize that approaching a dissertation and committee relationship like I did was taking a great risk and could have been an educational disaster. But because of the integrity of these individuals and their keen desire to learn as well – inherently exemplars of what we have discussed above, there was no risk. They were truly excited. The lead professor in education took on a doctoral student he really did not have time for, as he had a high number of his own. And my committee had to spend more time learning alongside of me so they could make good judgments about my work and its potential contribution to the field as research. Together my technology committee members and this education professor, all of whom were only willing to do this together because of their respect for each other as researchers, teachers, and most importantly learners, worked with me to learn enough to design and execute an experimental study on information processing of technical information. This is truly an example of what we are discussing here.

What a committee! What "special" professors who spent all the extra time it took for them to learn with me since they could not approve what they did not know about. We all learned together. It was terribly difficult, although the study may not reflect how difficult preparing to do it was. It was also wonderfully exciting and stimulating! It took me where my natural interests wanted to go – across disciplines. It engaged me in learning well above my current knowledge and experience; important for their outcomes was that the research contributed to the literature and body of knowledge on learning. Most importantly, they "let" me. This was teaching and research entwined at its best from both the student and professors' perspectives. To me, this is the goal for us in higher education. Every student should have some of these stories to tell about their educational experiences.

We will gradually move our faculty members into consideration of this type of endeavor, but our initial focus is a faculty learning community made of interdisciplinary learning circles, with the primary learning agenda including teaching pedagogy, student learning, student assessment, and educational research as we entwine teaching as scholarship with new teaching practices and a goal of increased student learning. Student learning communities and/or faculty-student learning communities are a teaching strategy within our initiative context. Anderson et al. (2003) inform us that their context of faculty development as a research university positions them to deal with the public call for more full time, senior, and experienced faculty members to teach undergraduate students. Their model is truly focused on the interdisciplinary faculty-student model. As they describe, our learning community will fit within our existing structure and will be coordinated by one individual. Their model

exemplifies an interdisciplinary faculty learning community or an interdisciplinary faculty/student learning community model.

Shapiro and Levine (1999) provide a practical guide for creating faculty/student learning communities. They also focus on the development of faculty/student and student LCs and provide a full guide on the issues, strategies, background, etc. very similar to the briefer version by Anderson. This will be an important resource for our faculty members when we determine the development of faculty-student learning communities is our goal or strategy. Presently, we are developing a faculty learning community; however, their exhibit on learning principles and collaborative action can serve to inform us about student learning as well as classroom research.

Figure A.4.3: Learning Principles and Collaborative Action

EXHIBIT 6.2. LEARNING PRINCIPLES AND COLLABORATIVE ACTION.

1. Learning is fundamentally about making and maintaining connections: biologically through neural networks; mentally among concepts, ideas, and meanings; and experientially through interaction between the mind and the environment, self and other, generality and context, deliberation and action.
2. Learning is enhanced by taking place in the context of a compelling situation that balances challenge and opportunity, stimulating and utilizing the brain's ability to conceptualize quickly and its capacity and need for contemplation and reflection upon experience.
3. Learning is an active search for meaning by the learner—constructing knowledge rather than passively receiving it, shaping as well as being shaped by experiences.
4. Learning is developmental, a cumulative process involving the whole person, relating past and present, integrating the new with the old, starting from but transcending personal concerns and interests.
5. Learning is done by individuals who are intrinsically tied to others as social beings, interacting as competitors or collaborators, constraining or supporting the learning process, and able to enhance learning through cooperation and sharing.
6. Learning is strongly affected by the educational climate in which it takes place: the settings and surroundings, the influences of others, and the values accorded to the life of the mind and to learning achievements.
7. Learning requires frequent feedback if it is to be sustained, practice if it is to be nourished, and opportunities to use what has been learned.
8. Much learning takes place informally and incidentally, beyond explicit teaching or the classroom, in casual contacts with faculty and staff, peers, campus life, active social and community involvements, and unplanned but fertile and complex situations.
9. Learning is grounded in particular contexts and individual experiences, requiring effort to transfer specific knowledge and skills to other circumstances or to more general understandings and to unlearn personal views and approaches when confronted by new information.
10. Learning involves the ability of individuals to monitor their own learning, to understand how knowledge is acquired, to develop strategies for learning based on discerning their capacities and limitations, and to be aware of their own ways of knowing in approaching new bodies of knowledge and disciplinary frameworks.

Source: American Association for Higher Education, American College Personnel Association, and National Association of Student Personnel Administrators, 1998.

(Shapiro & Levine, 1999, p.119)

Lenning and Ebbers (1999) provide a full resource for developing student learning communities. They identify the types: curricular, classroom, residential, and student-type learning communities and itemize the benefits. They recommend how to create and implement optimal college student learning communities by making the active learning oriented to where cooperative or collaborative learning is a teaching and learning strategy and identify the problems or pitfalls and responses or potential solutions to some of the problems.

The following figures from Lewis and Allan (2005) provide a model for virtual student learning communities that illustrate the dynamics within the virtual learning community and the transfer of knowledge between members of the community (students and facilitator). Further discussion of Lewis and Allan's work can be found in the literature review.

Figure A.4.4: Sample Virtual Learning Community

Figure 2.1 Simple virtual learning community

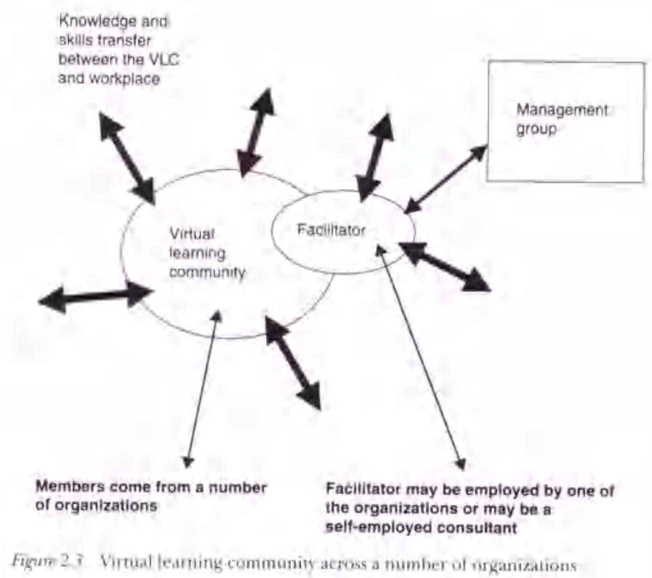
(Lewis & Allan, 2005, p. 22)

Figure A.4.5: Transfer of Knowledge

Figure 2.2 Transfer of knowledge into the workplace in a simple virtual learning community

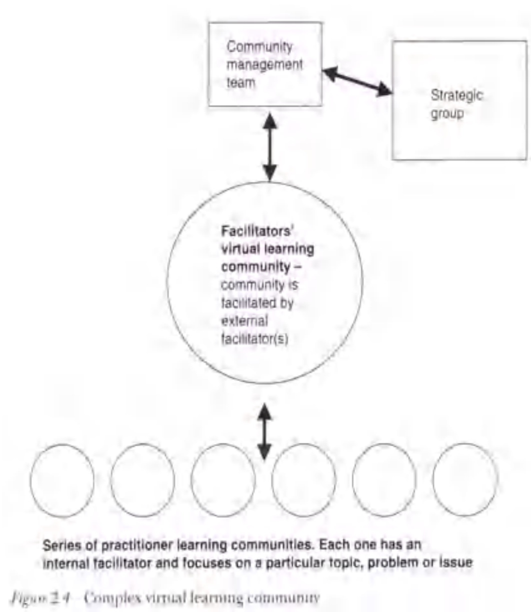
(Lewis & Allan, 2005, p. 24)

Figure A.4.6: Organizational structure



(Lewis & Allan, 2005, p. 25)

Figure A.4.7: Series of Practitioner Learning Communities



(Lewis & Allan, 2005, p. 28)

These authors and their models both inform and confirm the direction of this initiative and the strategies for accomplishing its mission.

REFLECTIVE PRACTICE: THE SCHOLARSHIP OF TEACHING
THE CEET FACULTY DEVELOPMENT MODEL AND PROGRAM
Jule Dee Scarborough, Ph.D.

The CEET Initiative on Teaching and Learning (CITL) – the Scholarship of Teaching - began with the Dean and Faculty Leader, a distinguished professor and teaching and learning expert, meeting to develop a college vision, mission, goals, and faculty development program focus. The Dean's leadership set the stage for the program, as he wanted the Scholarship of Teaching to become an equal realm of scholarship for professors across the three engineering and technology departments. His interests extended to include a desire for the college to become a regional and, ultimately, a national leader in the Scholarship of Teaching. Included in the overall vision was to become a leader in the preparation of faculty on teaching and learning so they could better engage and become leaders in the Scholarship of Teaching. Another aspect of his interest was that he recognized the expertise and leadership available within the college and wanted to create an environment for those professors recognized outside the college as leaders to have the opportunity for "local" leadership (internal to the college) with their peers; thus he was interested in a Peer Leadership Model. Therefore, his interests and those of the Faculty Leader in the Scholarship of Teaching at the university level meshed, and an initiative was born for the College of Engineering and Engineering Technology on the Scholarship of Teaching. The Faculty Leader conceptualized, developed, and led the program. The Dean fully funded the pilot initiative, which included the participation of seven faculty members from across the four departments, the program leader, one program associate, a graduate assistant, and resources and materials. The budget in real fiscal commitment was over $100,000, fully funded by the Dean's Office (Boyer, 1990).

The NIU CEET Initiative is all about change. To implement the Scholarship of Teaching through classroom research, there was a need to first create a faculty learning community and then provide faculty development for the "community." A needs assessment was performed, overall goals were identified, the program was designed, and then both a literature and program search were conducted to determine if there were any existing programs, in part or whole, that matched our needs. We found no programs and very few components that could be pulled together to create the program that we felt was necessary to prepare the faculty community for the Scholarship of Teaching. The underlying philosophy of our program was that of engaging faculty members in a fully integrated program. Teaching, learning, and student assessment along with several other topics are not easily separated, as they are truly interdependent. We wanted a "program," not a series of workshops. We wanted to follow our faculty members into their classrooms, where they would begin their experimental research. That was also an important aspect of the "program" approach – to include the classroom research as a component of the faculty development program. Once the needs were clearly identified, the literature was reviewed and documented, and finally, the university Professional and Organization Development Network (POD), a network of faculty development professionals and units across universities nationally, was tapped to see if any other university had programs important to know about or draw from. We then developed our program and engaged in the development of faculty on the Scholarship of Teaching.

Research

There were two research projects inherent to the overall Initiative. (1)The Faculty Development Program content and process was a pilot development and research project and (2) the experimental classroom research, executed by each professor on teaching and learning with their students during the research semester component of the faculty development program, was the second research project. Therefore, the CITL – the Scholarship of Teaching - engaged the college in two substantial research projects that, although integrated, were clearly different and defined prongs of research when considering the Scholarship of Teaching: (1) the faculty preparation on teaching, learning, and educational research and (2) experimental research on teaching and learning with students in the classrooms (Boyer, 1990; Campbell & Stanley, 1963,1966, 1977; Zuber-Skerritt, 1992). See Final Reports on both in the A (Executive Summary and Table) and B (Detailed Data and Report) sections of this document.

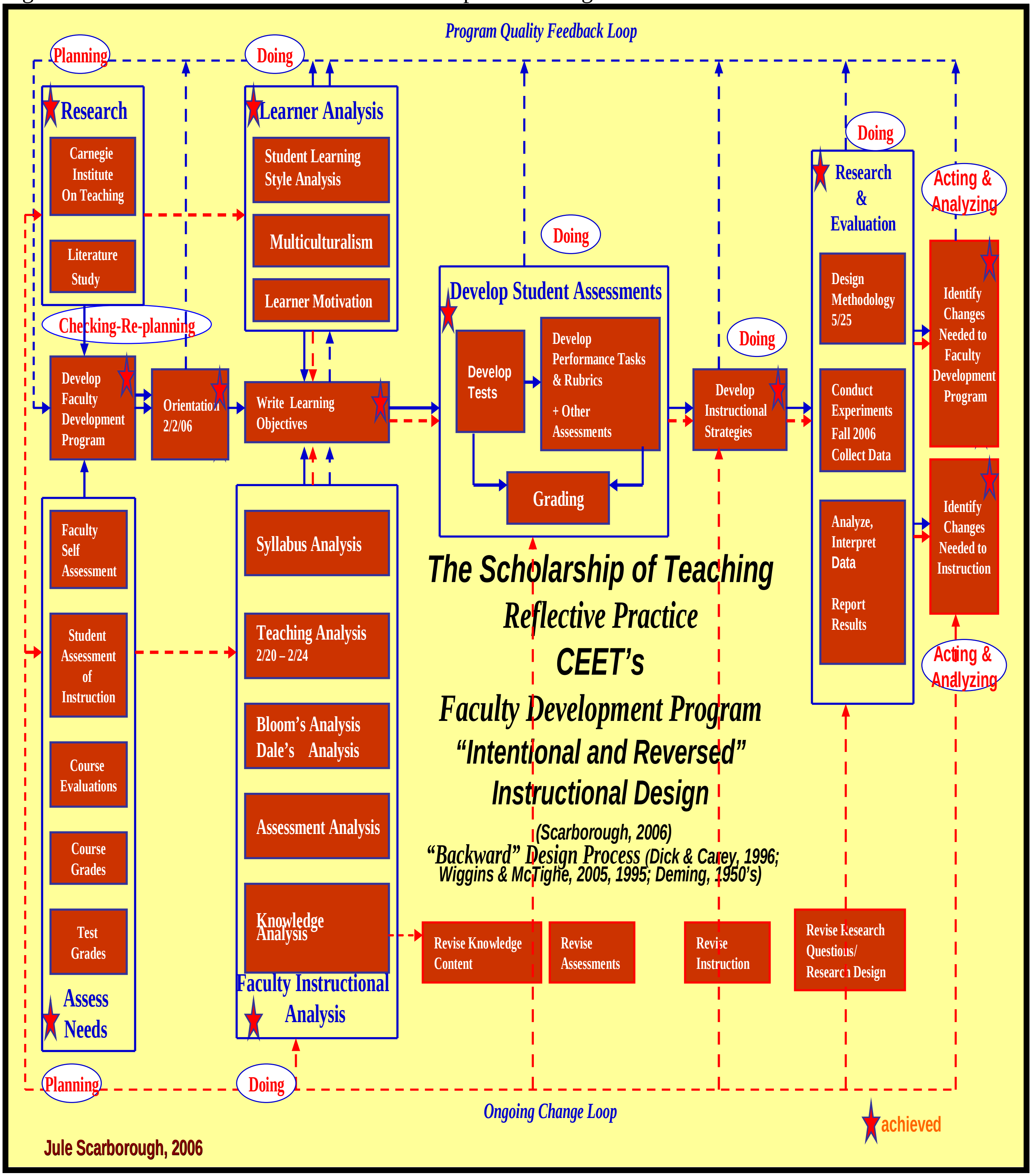
Timeline

The actual pilot initiative, not including the preparation and planning year, began with a formal Invitational and Commitment meeting in October 2005 and ended with data reports in January 2007. The actual faculty development program began in February 2006, ending in May 2006. The research semester following the faculty development program began in August 2006 and ended in December 2006. Classroom data was submitted during this semester. The quantitative data from the classroom experiments and partial qualitative data from the program evaluation were analyzed and presented to the faculty group and Dean in January 2007; the final qualitative data was presented to the faculty and Dean, May 2007. See Faculty Development and Professor Research sections of this document.

Table A.5.1: CITL Summary of Timeline (Basic Timeline)

Feb05 – Feb06	Planning and Preparation
Feb06 – May 06	Faculty Development Program (Data Collection)
Aug06 – Dec06	Classroom Research Semester (Data Collection)
Jan06	Preliminary Data Analysis –Critical Data Analysis
Feb06-May07	Completion of Data Analysis; Preparation of College Portfolio Portfolio Submitted to ERIC
Jun06-Aug06	NSF Proposal Preparation; Faculty manuscripts submitted to journals Portfolio disseminated to engineering/technology programs nationally

Figure A.5.1: Reflective Practice: The Scholarship of Teaching – The CEET Model



(Scarborough, 2006; based upon Dick & Carey, 1996; Wiggins & McTighe, 2005; Deming, 1950's)

The above model represents CEET's integrated model for The Scholarship of Teaching. The model integrates faculty preparation and classroom research, where the research on teaching and learning functions was the culminating learning activity within the faculty development program. The model is inherently designed to account for the quality of the program and the ongoing change process. Thus, the CEET model incorporates what others have done but modifies it to become a more integrated and intentional approach to critical reflection and the Scholarship of Teaching (Scarborough, 2006; based upon Deming, 1950; Dick & Carey, 1996).

The CEET model incorporates the "Reversed" Instructional Design Process first introduced by Dick and Carey as Systematic Design of Instruction (1996), where professors identify what they want students to know about or be able to do and then determine what assessment will best provide evidence that the learning has occurred. From that point, other instructional decisions are made (e.g., curriculum context, learning activities, teaching models, styles, and more). Then Wiggins & McTighe (2005) introduced the same principles as "Backward Design" . Dick and Carey's and Wiggins & McTighe's models have been modified for our purposes, and we show the entire process for the entire initiative. However, a major concept underlying our efforts can be best defined by the term "Intentional" Instructional Design; we adapted "reversed", although long a practice in technical fields. "Intentional" may best be explained when considering "natural" teachers or those professors who can enter a classroom without much preparation or thought about what they want to occur and something good will happen; students will learn something important. But did they learn what they should have learned? Was there a planned focus for learning? Instruction should be "intentional"; in other words, the "what-outcomes," and "assessment" (evidence of learning) should be thought about, identified, and prepared for in advance of walking into the classroom. When a professor leaves the classroom, he/she should leave with an understanding that what was planned or intended as outcomes for that day occurred and, at some point, collect evidence of the learning that took place. If for some reason, students did not achieve what was "intended," then the feedback process would indicate that something needs to occur to ensure learning.

The CEET model also incorporates the Deming Cycle (1950s) as the quality model and an inherent feedback loop that streams ongoing quality information into that cycle for continuous improvement. The model reflects a closed loop process for ongoing change. Thus evaluation is incorporated more naturally. CEET's model is comprehensive in that it prepares faculty for teaching and learning and educational research. The learning process engages professors in the redevelopment of one of their own courses as the vehicle to learn about teaching and learning and then adds a component on educational, experimental classroom research to prepare them for the research (and evaluation) aspect, using both the redeveloped course and classroom research as the vehicle for the professors to engage in their first and formal experience on the Scholarship of Teaching.

The process for faculty development was often very simple, while at other times, fairly complex. Although there were presentations, each noted on the program description and calendar below, the instructional model for the program was outcomes oriented, performance based, learner- knowledge- and assessment-centered, and also very actively engaging. The professors were assessed for knowledge and skill gains throughout the entire program. The program was somewhat collaborative; in this, I mean that faculty members were very focused on the analyses

and redevelopment of their own individual courses and instructional decisions, so they did not "engage" together to perform most of the development. However, they were encouraged to engage with each other for ideas, examples, assistance, or discussion at any time. Also there were formal collaborative group forums, discussions, and exchanges many times throughout the program. There was also formal cooperative learning, where faculty members engaged in the jigsaw process to bring different information on a topic together to complete the whole picture or perspective from a variety of sources individually assigned. This made learning more efficient as well as engaged the faculty members in formal cooperative or collaborative learning.[1] The professors' (student) learning outcomes for the program were

I. To analyze each existing course to
   a. determine appropriate content knowledge for achieving ABET(EAC/TAC)/NAIT standards or student learning outcomes
   b. determine knowledge content priority: major, secondary, other or minor
   c. determine how knowledge fits into Bloom's Taxonomy Knowledge dimensions
   d. determine the embedded general education goals
   e. determine appropriate teaching models and styles
   f. determine which student learning styles are being engaged
   g. determine the levels of Bloom's Taxonomy Dimension of Learning are being achieved
   h. determine the levels of Dale's Cone of Learning being achieved passive - active
   i. determine strengths and weaknesses of the course
   j. determine strengths and weaknesses of instruction
   k. determine strengths and weaknesses of syllabus
   l. determine strengths and weaknesses of student learning

II. To analyze all tests to
   a. determine the overall quality of the test
   b. determine the overall quality of test items
   c. identify strengths and weaknesses of existing tests
   d. map test relationship to course outcomes
   e. map test items to course outcomes
   f. analyze other assessments (very few) for quality
   g. analyze other assessments (very few) relevant to learner outcome

III. To redevelop course outcomes that directly link to ABET(EAC/TAC)/NAIT
   a. redevelop the course outcomes and map relationship to ABET(EAC/TAC)/NAIT
   b. break down outcomes in outline form - major, secondary, minor levels
   c. identify knowledge according to Bloom's Knowledge Dimensions
   d. identify embedded general education goals
   e. map outcomes to Bloom's Dimension of Learning levels
   f. map outcomes to Dale's Cone of Learning levels

[1] All outcomes achieved level.

IV. To re-develop tests that directly link to course outcomes and ABET(EAC/TAC)/NAIT

- a. create a table of specifications
- b. develop a bank of diverse test items, multiple items for each outcome
  1. multiple choice
  2. true/false
  3. short answer
  4. matching
  5. problems
- c. assemble two comprehensive tests
  1. midterm
  2. final examination
- d. administer newly developed tests

V. To develop a more multifaceted and balanced student assessment plan

- a. develop three complex performance tasks with corresponding rubrics
  1. task and rubric that corresponds with the midterm exam
  2. task and rubric that corresponds with the final exam
  3. task and rubric to further enhance the more balanced assessment plan
  4. incorporate student self-assessment using rubrics
- b. develop other types of student assessments to further diversify and balance the course assessment plan; choose from or determine:
  - a. quizzes
  - b.
  - c. projects
  - d. case studies
  - e. papers
  - f. reports
  - g. literature reviews
  - h. design problems
  - i. presentations
  - j. concept mapping
  - k. team projects
  - l. field experiences
  - m. simulations
  - n. portfolios
- c. employ student self-assessment procedures on particular or all assessments

VI. To reconsider grades, grading criteria and processes

- a. eliminate curving of grades
- b. determine grading criteria
- c. determine scoring protocols
- d. implement rubrics
- e. implement student self-assessment
- f. determine formal course assessment grading, scoring structure

VII. To reconsider other instructional decisions by increasing the repertoire of options:

a. choose a broader repertoire of teaching models to use in the redeveloped course
b. choose a broader repertoire of teaching styles to use while teaching the re-developed course
c. provide a wider range of learning opportunities that engage a more diverse range of student learning styles
d. consider multiculturalism and its effect on student learning and planning instruction
e. consider student motivational factors in making instructional decisions
f. consider student perception factors in making instructional decisions
g. consider improvements of learning environment and learning space arrangements (possibly second program phase)

VIII. Determine, design, develop…finalize

a. contextual curricula
b. learning activities
c. group or team learning and assessment processes
d. other instruction delivery (e.g., learning style inventory)

IX. Redesign and develop new course syllabus incorporating the following categories:

a. professor, graduate assistant contact information
b. catalog course description
c. course purpose
d. course requirements: text, datebook, curricular course packets, etc.
e. course pre- or co-requisites
f. expected computer use, knowledge, skills, software, etc.
g. student learning outcomes, identifying embedded general education goals, and showing connection to ABET(EAC/TAC)/NAIT outcomes with links to assessments
h. course schedule/timeline showing course weeks/days, topics, activities, due dates, lectures, tests, projects, fieldtrips, etc.
i. course requirements: list assessments and points, percentages, structure, etc.
j. grading structure
k. academic misconduct or cheating policy
l. professor’s role; graduate assistant role
m. professor’s notes: particular notes about expected behavior, rules, tardiness, absenteeism, cell phones, late assignments, etc.
n. support services available to students, e.g., Writing Center, tutorial services, accessibility/accommodations services, etc.
o. course references
p. course requirements explanation – description of each type of assignment
q. course requirements check off – list of all assignments, projects, activities with point, percentage, scoring, or grading information so students can keep track of their progress in course more easily.

X. Conduct classroom research on teaching and learning

a. design research
b. select methodology and procedures
c. conduct experiment
d. collect data
e. analyze and interpret data
f. develop conclusions and recommendations
g. prepare manuscripts for publication

The learning process was led rather than "imparted." A myriad of worksheets, information handouts, and tasks were used to accomplish most of the work. Although extremely intense and demanding, the analyses, learning processes, and development activities were directly tied to educational products and strategies to be used during the redeveloped course when it was offered Fall 2006, the experimental research semester. (See Portfolio Section C1) Therein is the foundation for the commitment and work ethic required of the professors and also demonstrated by the professors. Everything they engaged in was for the course improvement, enhancement of their teaching, and ultimately increased student learning.

To measure professor learning on each program component, both objective tests and performance tasks were used as well as alternative assessments (e.g., self-competency assessments and others). Sometimes multiple tools were employed to measure professor learning. The educational products or tools developed by the professors were the result of their performances; these were judged qualitatively to determine the quality and level of their achievement. Thus, the faculty development program involved assessment <u>for</u>, <u>of</u>, and <u>as</u> learning using traditional, performance, and alternative assessments. For a full discussion on assessment, especially performance assessment, see Scarborough, 2004, Chapter 12, copied into this document. See Portfolio Sections A5.

Program Description

The results of this program can be found in Section B.0-B.13.

Planning and Preparation for the Initiative (February 2005 - February 2006)

The program was based upon relevant past and current research, studies, best accepted practices and models in the literature, and books by a host of well known and nationally acclaimed authors on teaching, learning, assessment, educational research, and more. The program leader conceptualized a program based upon experience working with grant funded teaching and learning initiatives with high schools and partner post-secondary education institutions. The work of these partnerships was complex; involved large numbers of teachers, instructors, and professors; and provided extended time with the groups (Scarborough, 2004; strategicalliance.niu.edu). The national call for the Scholarship of Teaching by Boyer (1990) and The Carnegie Foundation motivated the design and development of a "program" for higher education, and although it can be used for any group of professors, the program leader was predominantly concerned with engineering and technology professors. To confirm the ideas for the program and to more fully validate the program concept and topics, a full literature review focusing on teaching and learning at the university/college level was prepared. Rather than have each professor perform his/her own complete review, it was determined that one effort on the part of everyone involved would be more efficient, productive, and cost effective. Therefore, all

participating faculty members were provided the entire review, with a great many hardcopies of selected articles, books on critical topics, and examples of educational products available from the literature (e.g., different types of rubrics, etc.). The literature search and review was wider and deeper to not only validate the program content but also to provide direct program support for the professors. Since the program was comprehensive, the review had to reflect that framework. It covered an extensive realm of literature on teaching and learning; most of it can be viewed within this portfolio. The literature review purpose extends beyond the traditional purpose of establishing the baseline and justification for research and development. Our review is also for the purpose of teaching. We wanted a review that would make it easier for the professors to begin to develop their own schema about teaching and learning. Although it would have been a great foundation for them to each study more deeply the wide range of literature available on teaching and learning, we had to consider motivation and time and decided to try introducing them to the literature this way. Therefore, a complete list of articles, books, etc. is included that reveals the information in each professor's educational toolbox. There is also a third reference list more directly related to engineering. The program leader began to prepare for the initiative approximately one year before the work with the professors began. That also gave the Dean time to allocate the budget needed for initiative execution. See References, Toolbox Lists, and Sections A8.

Participants and the Commitment Meeting (October 2006)

Once the preparation aspect was somewhat completed, the selected professors were invited to participate by the Dean. In determining who would be invited for the pilot initiative, we decided that a diverse group was best and that it should include individuals who would be both interested in such an initiative and willing to engage sincerely to accomplish the goals of the faculty development program and research semester. Although not randomly chosen, as preferred for the research aspect, the professors ranged widely in their teaching capability, styles, methods, and experience. Clearly, however, all were engineers and technologists with no formal background in teaching, learning, assessment, or educational research. Ultimately, the purpose of the meeting was to (a) explain the full realm of the initiative; (b) help each potential participant realize the level of involvement that would be required; (c) explain the initiative's relationship to the professoriate, professors' responsibilities and duties; (d) explain the reward structure; (e) answer all questions; and (f) confirm the commitment of each faculty member. Table 1 below provides the program calendar. Each program component is explained in the following sections.

Table A.5.2: CEET Initiative on Teaching & Learning Spring Semester Schedule (2006) (*assessment)

Thursday, Feb. 2	Thursday, Feb. 9	Thursday, Feb. 16	Thursday, March 2	Thursday, March 23
Orientation - Presentation **Faculty Roles, Respons., Duty** **The Scholarship of Teaching – The National Call for Action** **Action Research** **Learning Communities** **Knowledge Communities** **Communities of Practice** **Teaching Professionals** **What is Learning?** **What is Learning Pedagogy?** **Self-Assessment: The First Step in Reflective Practice** **Program Description & Model** **Student SWOTs Analysis** **10/11/05–** Commitment Mtg. -Program Description -Requirements -Timeline -Expected Outcomes -Rewards ***LC Assessment (a)** ***Self-Competency (a)**	**Course Analysis - Presentation** **Knowledge Content Outlines** **Knowledge Priorities** **Embedded General Education Goals** **Student Learning Objectives and Outcomes** **“Reversed” Instructional Design Model – Intentional Design** **Taxonomies of Learning** **Dale’s Cone of Learning** **Objectives & Outcomes By Bloom’s Taxonomy and Dale’s Cone** ***SLO Assessment (a)**	**Course Analysis (cont.)** **Objectives & Outcomes matched to assessments** **Assessments by Bloom and Dale** **Critical Thinking** **Teacher, Knowledge, Assessment, or Learner Centered?** **Test Analysis – Presentation** **Purpose of Test Analysis** **Item Analysis** **Item Difficulty** **Item Discrimination** **Case Test Analysis** **Flagged Items** **Analysis of Results** **Validity** **Reliability** **Standard Error of Measurement** **Using NIU’s Testing Services** ***Test Analysis Assessment (a)**	**Course Analysis (cont.)** **Teaching Models** **Teaching Styles** **Learning Styles** **Instructional Design Analysis** **Double Loop Learning** **Complete GAPS Analysis Summary** **Active Learning** **Problem-based Learning** **Growing up Digital** **Syllabus Analysis**	**Course Development** **ABET/TAC/NAIT Standards – Student Outcomes** **Outcomes by Bloom’s** **Course Calendar** **Introduction** **Syllabus Development** **Super Syllabus** *** Student Learning Objectives –Outcomes Assessment - SLO (a)**
Thursday, March 30	**Thursday, April 6**	**Thursday, April 20**	**Thursday, April 27**	**Break April 28-May 14**
Test Development - Presentation **Discrete, Objective Items** **Test Items/Bloom’s Taxonomy** **Case Test** **Valid Test Items** **Constructing Multiple C. Items** **Constructing Short Answer It.** **Develop Items-submit** ***Test Analysis Re-assessment (b)** ***Test Dev. Assessment (a)**	**Test Development** **Item Writing**	**Test Development** **Item Writing** **Test Development**	**Test Development** **Midterm Exam Test Assembly** **Final Exam Test Assembly** ***Test Development Reassessment (b)**	**See you in May!**

Table A.5.3: CEET Initiative on Teaching & Learning May 15-25 Schedule (*assessment)

Mon., March,15-, 9am-5pm	Tues., March 16, 9am-5pm	Wed., March, 17, 9am-5pm	Thurs. March, 18 9am-5pm	Fri., Mar. 19
Regroup Day -Test Analysis, Development, Assembly Review SLO/Test Item/Bloom Analysis Continue SLO activities TEACHING PORTFOLIO Portfolio Organization THE CITL TOOL BOX Tool Box Organization Each Professor builds his/her own Tool Box *TD/A Re-assessment (c)	Performance Assessment & Rubrics - Presentation* Performance Assessment & Rubric (PAR) Development PAR #1 Share and Critique with Peers *See PA Chapter & Reference Materials *SLO Reassessment (b)	Reflective Practitioners - Presentation Development PAR #2 Share and Critique with Peers Development PAR #3 Share and Critique with Peers *See PA Chapter & Ref. Materials *PAR Assessment - Products	Balanced Assessment Course Assessment Plan PAR development - finalize Perform PAR Bloom Analysis Other Assessm. types Map Assessments (Kuhs et al.) Identify- types of assessment to include in Course A. Plan Develop descriptions, products for each type Explain Friday's Assignment	9am-5pm Teaching Models ON OWN Reading Assignment Learning Activity *TM Assessm. Product
Monday, M22 9am-5pm	Tuesday, M23 9am-5pm	Wednesday, M24 9am-5pm	Thursday, M25-9am-5pm	Summer!!
Cooperative Learning - Presentation Mapping as Assessment & Active Learning - Map Courses Complete Assessment System -Review TM/TS/CL/M Mean/Use -Review St. LS-Kolb Model -Review Dale's Cone-Analyze A. Course Content Schedule Teaching Decisions - TM, TS, St. LS Course Calendar Completion Multicultural Assignment -JS	Multi-Culturalism in Course Apply MC in course *Revisit Cooperative Learning Complete Assessment System Complete T/L Decisions What does your Syllabus COMMUNICATE - or NOT!! The MODEL SYLLABUS Syllabus Completion Grading Assignment-JS	Grading What Competencies do grades communicate? Plan LC Goals and Activities 12-1 Lunch with Dean Vohra Program Assessment DISC. Complete Portfolio Teaching & Learning Assign. Scholarship of Teach. Assgn. Discuss Dean/Chair Meeting *Portfolio Assessment (a) * Map Program *LC Reassessment - (b)	9-11 Classroom Research Experiments – Presentation Review Teaching & Learning Scholarship of Teaching 2:00-4:00 Dean Vohra Dept. Chairs Meeting/Profs. Program: Presentation Reflective Practice & Change Learning Community Teaching & Learning Scholarship of Teaching Set Fall LC dates 4-5pm *Program Assessment *Self-Competency Re-ass(b)	See you on: 1.Summer-Research date 2.Fall dates: a. Regroup b. MT/Final Test Analysis & Review date c. End of Semester d. Data Review e. Art. Meet.

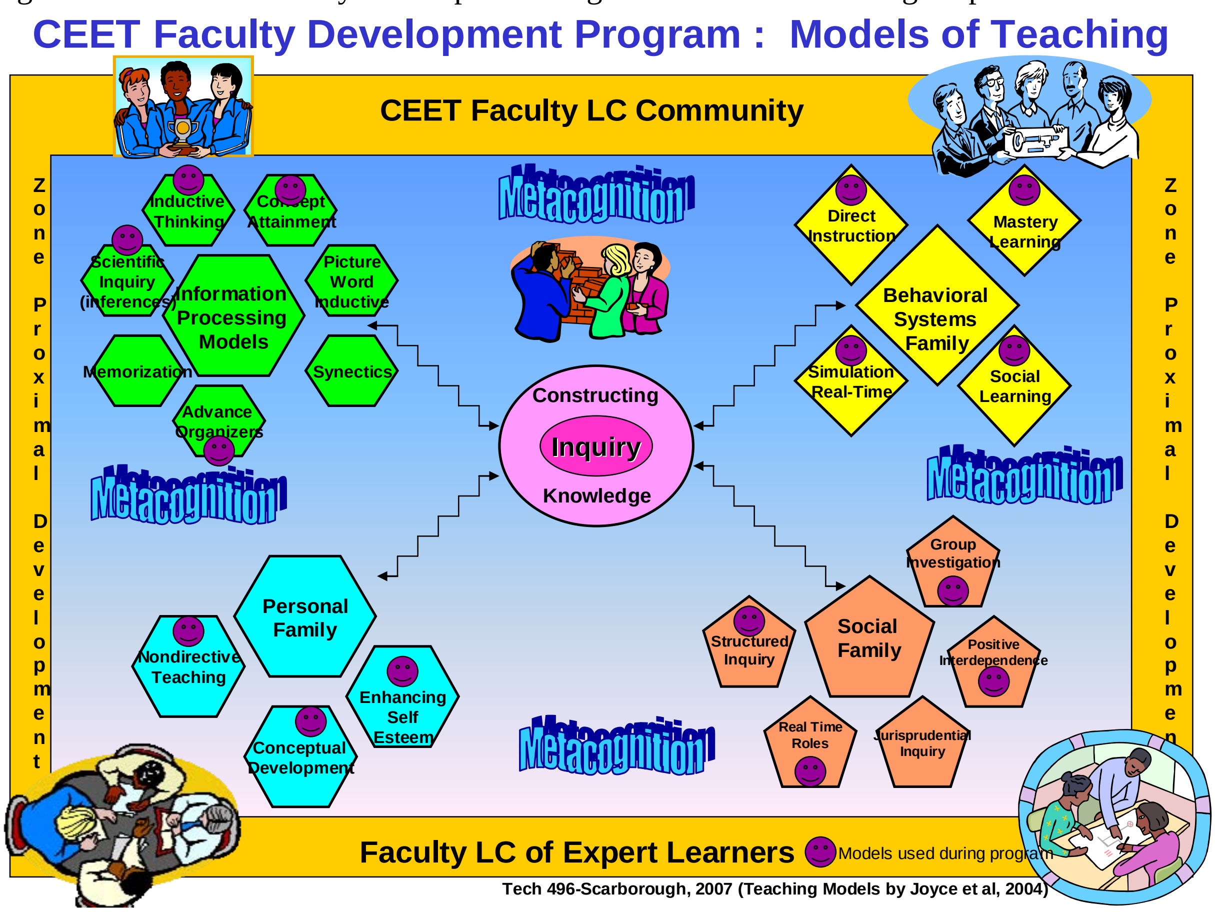
Program Orientation (February 2006)
The program orientation included an introduction to the Scholarship of Teaching and an explanation about learning communities, with a focus on what learning means. Orientation continued with a full description about what the faculty development program focus and topics would be with a description of all educational products, instructional decisions, and activities expected from the professors as well as a description of the operational model: assessment as learning; active and engaged learning; and traditional and performance based assessment. The program leaders described that the standard for teaching the program would be they would use the teaching models and styles of focus within the program content and they would also model best practices and behaviors when leading the program. Finally, the learning community goal was discussed; the process would be one where the faculty could engage to evolve their own learning community as an interdisciplinary group. Orientation concluded with an explanation about "Intentional" Instructional Design and the "Reversed" Design process (Dick & Carey, 1996). Finally, the professors engaged in a basic SWOTs (Strengths, Weaknesses, Opportunities to Improve, and Threats with addition of "s" for solutions where there are weaknesses or threats) analysis of students and student learning. Some professors viewed this from a program and teaching perspective; others from the student perspective; and still others from both perspectives. Nevertheless, the results provided another type of thought provoking validation for the faculty development program and research initiative. See Presentation PowerPoint – D2

Faculty Development Program: Comments on Teaching and Learning
It is important to understand that these professors, even those who had attained some knowledge or had some sense of the educational aspects of teaching and learning, had minimal to no background on the art and science of teaching and student learning. A few had attended workshops or read articles and books and then tried some of what they learned in their own classes. None had engaged with peers on teaching and learning. Therefore, when designing the program, our struggle was about how much breadth and depth to provide on the knowledge content of teaching, student learning, assessment, and instructional models, practices, or procedures, and educational research because each topic could, in itself, be a course.

Philosophically, the leader's goal was to provide a "program" rather than a series of artificially separated workshops because a program presents the content as it really plays out in the classroom – integrated; a program provides the opportunity for participants to actively perform and produce what they need in their classroom. A program does not end with presentation of information; it takes the professors from analysis of courses and instructional practices through learning, making changes, and ultimately, performing in the classroom. We made the decision to go broad in program content with more depth and time on particular topics. We wanted the parameters to include course analysis to identify strengths and needed improvements, the determination of student learning outcomes; student assessment beyond tests (performance assessment); and something on grading. We also wanted to address teaching models, styles, student learning styles, and multiculturalism, student motivation, and perception factors. We did this <u>and</u> <u>more</u> with the greatest amount of time spent on course analysis, testing, performance assessment, and teaching models. See the Program Calendar and Portfolio.

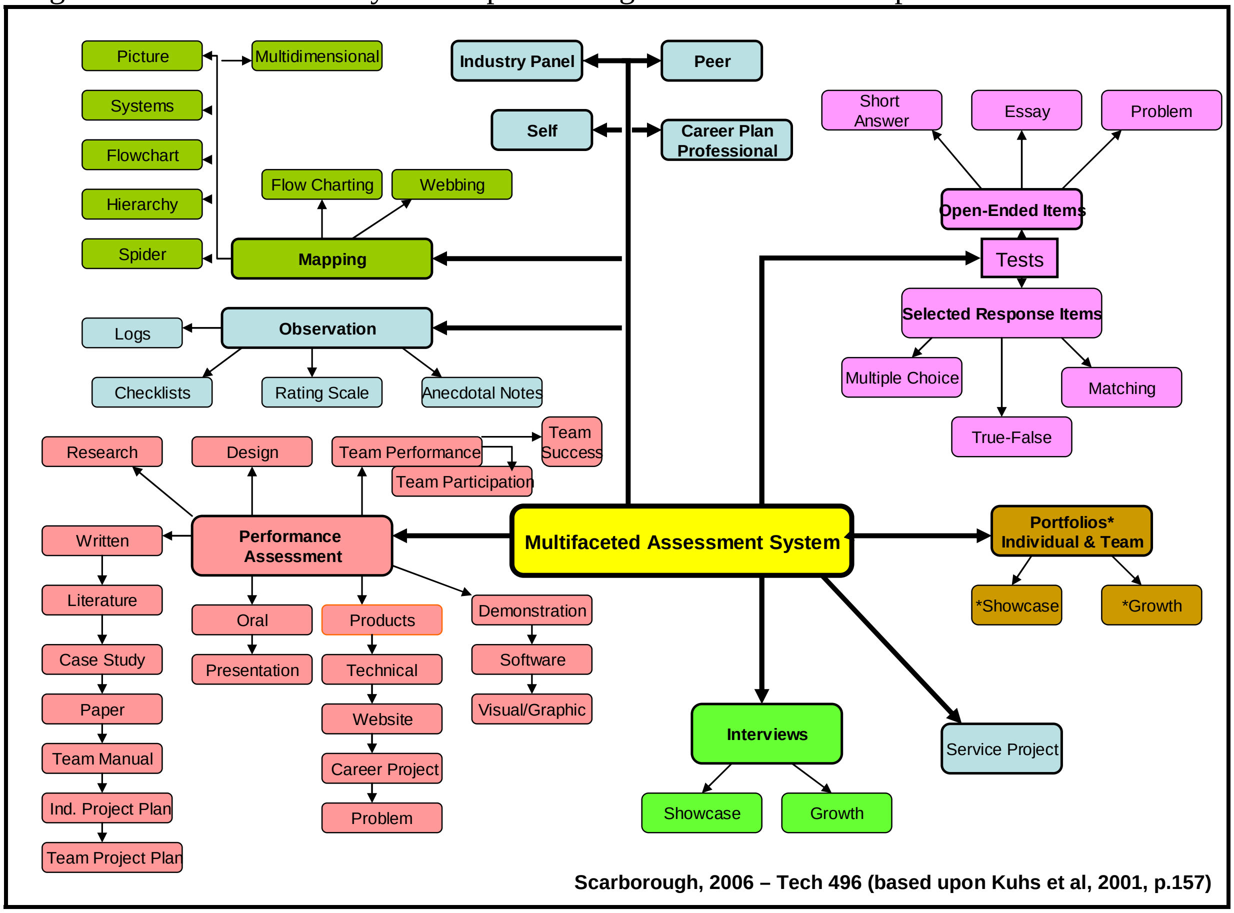
Another difference in a program versus a workshop series approach should be, and was for us, that we tried to provide each professor with a “toolbox” of the references and materials needed to continue on their own after the faculty development and classroom research experience were completed. We have found through previous experiences with other groups that individuals and small groups will continue to evolve, especially if they have everything needed right in their own offices. Therefore, each of our professors left the program with a “toolbox” or files of articles, books, examples, worksheets, aids, and more to make it easy for them to continue changing as teaching professors and to also change their other courses. Also we were committed to modeling the models, techniques, and behaviors that we were trying to evolve the professors into formally using in the classroom.

Figure A.5.2: CEET Faculty Development Program Models of Teaching Map



Having explained our philosophy, it is important to understand that in 18 full 8-hour days, plus several other shorter meeting days, we covered a lot of topics broadly, and some more deeply. The program was learner-knowledge-and assessment-centered using both self- and other formal-assessment procedures, but with a wide variety of assessment opportunities, including the culminating ones of a Teaching Portfolio followed by experimental classroom research. A brief description of the program and each component is presented below. Portfolio products are identified where appropriate. The professor assessment results are presented in the Data and Reports section. (See Portfolio Sections B1-13)

Figure A.5.3: CEET Faculty Development Program Assessment Map



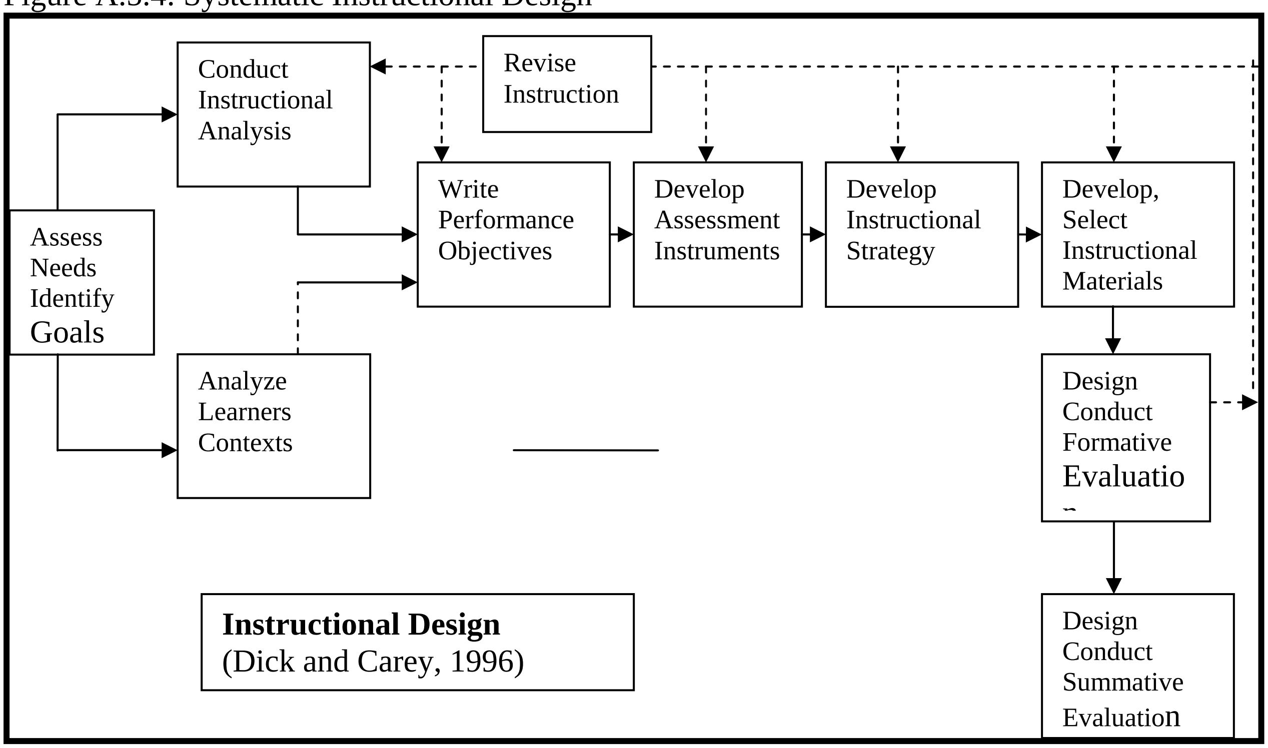
In striving to validate, benchmark, or inform ourselves further, the search for faculty development "programs" sought not only current and relevant literature but also offerings from faculty development offices across universities nationally. The Director of NIU's Faculty Development Office sent out an email requesting information on any type of related endeavor, whether workshop, seminar, or program. There were four responses; the content of those responses are described in the Faculty Development literature.

It might be important to know that we considered the "burden of learning" and who was shouldering that burden in the professors' classes. In analyzing their courses, teaching models, teaching styles, student learning styles, and the level of Dale's Cone and Bloom's Taxonomy that the course or student learning was achieving, the professors began to realize that the "burden of learning" was on them as professors, instead of on the students where it should be. The courses were teacher-and knowledge-centered rather than balanced across learner, knowledge, and teacher assessment. They learned that their courses needed to be refocused so that the burden of learning would become accepted and sought after by their students, thus transferring that burden from themselves to their students and motivating the students through ownership of their own learning. This perspective does not free the professors from continuously learning of new or deeper knowledge in their respective disciplines; instead it expands their activities to include true leadership of the learning process in their classes, where they lead instead of "impart," where students are active

participants instead of passive, and where inquiry and discovery are the foundation for learning. In the multiple analysis process, the assessments were analyzed equally beside the student learning outcomes, course content, teaching models, styles, and student learning styles. Throughout our sessions on student learning assessments, test analysis and development, and performance task and rubric development were developed towards higher levels of Bloom's Taxonomy and Dale's Cone as well. Often the focus of faculty development is on improving instructional practices, and the improvement of student assessments is not included. CEET's program addressed both. It connected the use of assessment analysis as a diagnostic tool for improving student assessment and instruction.

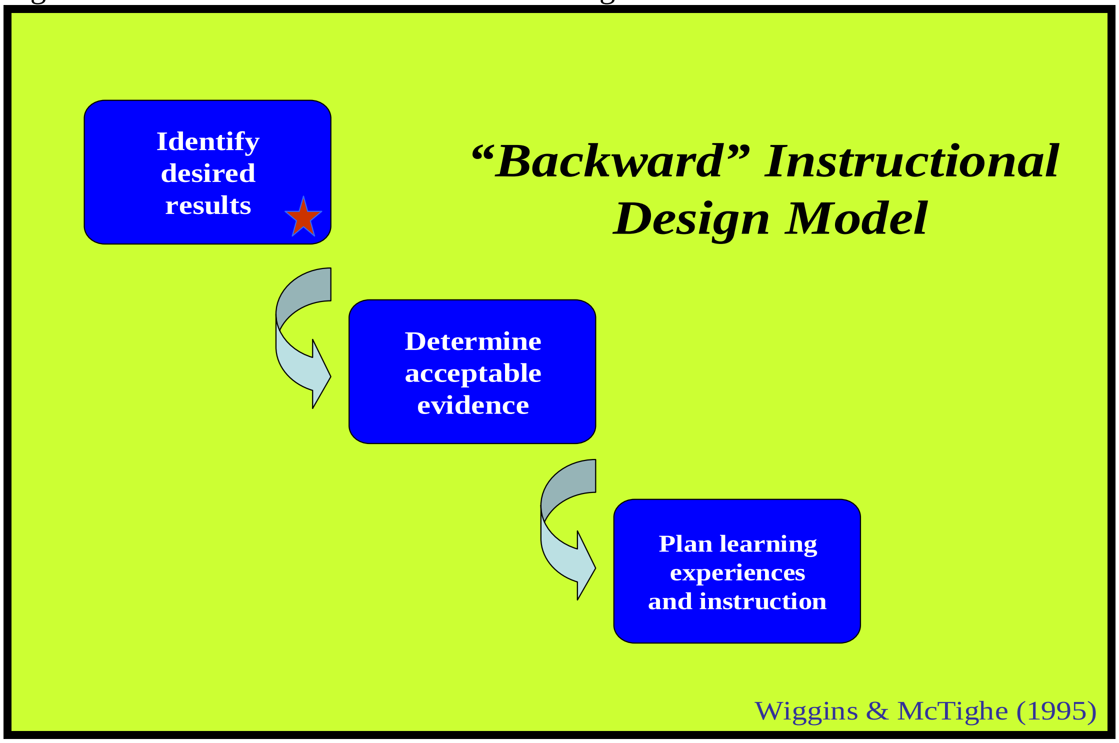
A fundamental underpinning of the entire program was the use of Bloom's (1956; 2001) (original and revised) Taxonomy of Learning, both the Knowledge and Cognitive Process Dimensions and Dale's (1969) Cone of Learning. Educators have long argued about the use of these models in planning curriculum, teaching, and learning activities, or student assessment. We made the decision to use these as fundamental parameters for almost everything we analyzed, considered and developed. Finally, it is important to know that other fundamental operational models for us were the "Backward" Instructional Design (Wiggins & McTighe, 2005) and Systematic Instructional Design by Dick and Carey (1996). We used the basic models and then modified them to suit our needs, "Reversed & Intentional" (Scarborough, 2006).

Figure A.5.4: Systematic Instructional Design



(Dick & Carey, 1996, p. 14)

Figure A.5.4.a "Backward" Instructional Design Model



The program could be considered to have two primary foci, each comprised of significant faculty development components. The first primary focus was to engage professors in deep, intentional, and critical reflection through analysis of the quality of their course, teaching practices, and assessment. Each professor selected a course to use as his/her experiment and focus for analysis and redevelopment. The professors were led through intense analysis of that course and their role as professor to achieve the above program outcomes. The second primary focus engaged the professors in using what was learned from the critical reflection to re-design and re-develop their courses, student assessments, syllabus, and to broaden their repertoire of teaching tools and processes by choosing additional teaching models and styles they would try in the experimental course. They also structured learning to broaden student learning style options throughout the learning process. They redesigned their syllabus, added a course calendar, and much more, as can be seen in the descriptions below.

Analysis of the 2005 Course

As the analysis and development process is presented below, readers could become confused by the terminology used to identify the course going through revision. Actually, each professor was engaged in the analysis and revision of one course each. However, we will call this same course two different terms, the 2005 and the 2006 course. Throughout the course analysis program components described immediately below, the focus was on analyzing the "existing" or "current" 2005 version of each of their courses. Once each professor analyzed that course through a series of analyses and progressed to the course development or "redevelopment" stage in the program, the 2005 course was redeveloped and improved; it then became the 2006 course to be taught during the 2006 experimental research semester.

Therefore, we are discussing one course, but it was re-developed and greatly changed throughout the faculty development program process.

Course Knowledge Content Analysis
Each professor analyzed his/her selected 2005 course for the quality of the knowledge content, using (Bloom's Knowledge dimensions: factual, conceptual, procedural, and meta-cognitive) to more deeply consider the knowledge they wanted students to learn in the course. Often professors and teachers had difficulty separating knowledge from skills, education from training, facts from information, and knowledge from other general information that serves as curricular context. Knowledge was usually considered to be fundamental concepts, principles, facts, constructs, ideals, etc. that underlie what might be considered broader information. We decided to approach it simply, using the Bloom's Knowledge dimension. Furthermore, professors did not often consider knowledge content priorities or the amount of course time that should be allocated to each knowledge piece or cluster.[2] Priority and course time allocations for content affect more than teaching, learning activities, and course design; the priority of course content and the time allocated to spend on teaching and learning also affects tests or other assessments. When leading professors to prioritize particular knowledge content for greater attention and instructional time, then proportionally the same had to apply to attention and time of the content on assessments. Also content priority could affect what type of assessment should be used to measure learning of particular content. The professors assigned priority status to their knowledge content at three levels: primary, secondary, and other or minor, and allocated instructional time appropriately. They also used these determinations when building the tests and performances as well as determining the other student assessments or assignments.

The professors were first asked to outline their existing 2005 courses for "knowledge" content; separating "knowledge" from "other" information was somewhat a challenge for them. They were more able to consider it from the perspective of "course content." Also it cannot be assumed that engineering and technology professors generally possess traditional outlining skills, especially if English is a second language and culture or language logic is different. When asking a diverse group to outline their courses by primary, secondary, and other minor but important knowledge or content, we found it was not an easily accomplished task. We did finally arrive at a point where each professor had a "list" of important knowledge content, which they itemized by priority: (1) "primary" or <u>must</u> include and spend the <u>greatest</u> amount of time on; (2) "secondary" or <u>important</u> and must spend <u>significant</u> time on; and (3) "other" important knowledge that needs to be <u>acknowledged</u> or mentioned, but <u>not</u> <u>much</u> time spent on it, and/or assign students to learn it on their own or outside of class time but still hold them accountable for it. Simply, the professors outlined or listed course

[2] This was the first event where the "time" aspect of a course or a course calendar was mentioned. None of the professors included a course calendar in their syllabus so students could see what course content and activities would be addressed each day or week or how long they would spend on it. Nor were many due dates firmly established or mentioned at all on most of the syllabi. Professors did not, themselves, seem to have any real sense of "knowledge content and time" for their courses. Of course, they had some intuitive sense (somewhat operational) about what they wanted to cover overall, but there was no "real" sense of the timeline tied to knowledge content, course activities, due dates for assignments, etc. There is more about this later when the professors reached the point of developing a course calendar to include in the 2006 syllabi.

content, broke it out into at least two levels (but most by three levels), and then prioritized and considered it regarding the time factor. Finally, most of them identified the course content by Bloom's Knowledge dimensions: factual, conceptual, procedural, and/or meta-cognitive for the purpose of making instructional decisions about more effective teaching strategies (Wiggins & McTighe, 2005). The simple worksheets below were used to organize the initial knowledge content analyses (See Figures A.5.5 and A.5.6). Also when knowledge content is balanced across all of Bloom's Knowledge dimensions, then there is the great possibility of achieving student learning at the higher levels of Bloom's cognitive process dimensions.

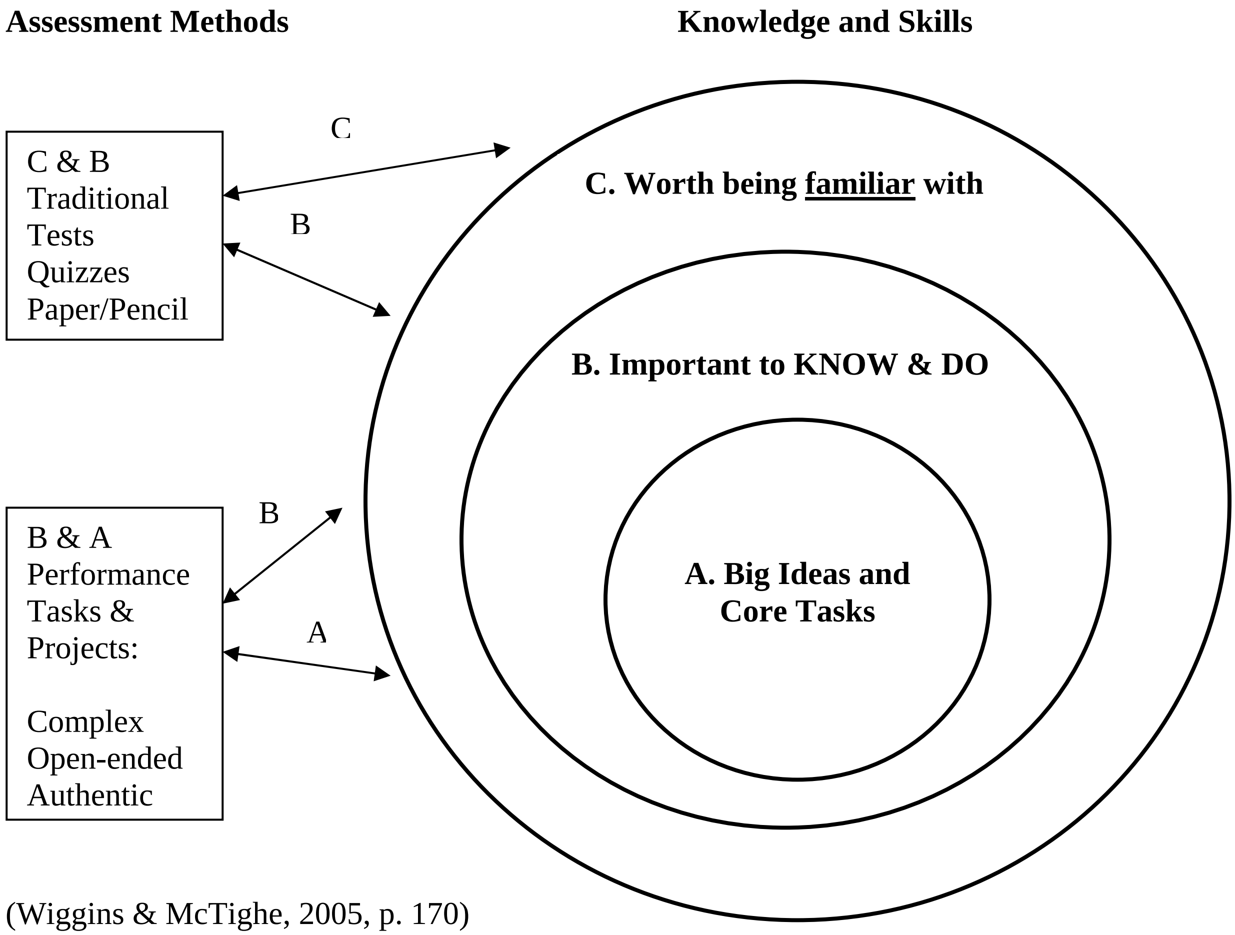
Figure A.5.5: Discipline Course Outline (See Section C1 for worksheet)

Course Disciplinary Knowledge Content	**Science(s) Foundation Required**	**Mathematics Foundation Required**	**Communication Skills Required**
(Id. Major and minor Concepts, principles, Facts, information,etc.)	(Id. Physics, Chemistry, Biology, etc.) Equations, etc.)	(Id. Algebra, Trig, Calculus, Differential technical, etc.)	(Id. written, spoken, graphical, listening)
I. Unit			
A.	A.	A.	A.
1.	1.	1.	1.
2.	2.	2.	2.
B.			
1.			
2.			
II. Unit			

Figure A.5.6: Course Knowledge Content Priorities

Knowledge addressed Content assign)	**Primary-major** (Allocate most time)	**Secondary** (Allocate significant time)	**Needs to be** (Mention briefly-
A.			
1.			
2.			
B.			
1.			
2. etc.			

Figure A.5.7: Clarifying Curricular Content Priorities and Assessment Methods



(Wiggins & McTighe, 2005, p. 170)

Course Mathematics, Science, and Communication (MSC) Analysis

Another aspect of analyzing the course knowledge content occurred from the mathematics, science, and communication perspectives. Each professor considered his/her knowledge content priority lists from these three perspectives and listed or outlined the necessary or expected pre-requisites or co-requisite knowledge or skills embedded within the engineering and technology knowledge content. This led us into consideration of what general education knowledge and competencies would be expected of students if they were to be successful in these courses (we used the NIU general education books). Illuminating those expectations was important so the professors could really focus on what they expected of students and, ultimately, what they expected of themselves and their own address of knowledge content in the course, discipline- or general education-based. This was beneficial and helped them to really flush out, or confirm, the top priority knowledge content for the course from both discipline content and the general education content, especially math, science, and communication preparation perspectives. Although usually consideration of the ABET(EAC/TAC)/NAIT standards or learning outcomes would come first, because our programs were already accredited, the courses (or course objectives) were already linked to the ABET/NAIT standards or learning outcomes. Therefore, the strength of the courses in achieving those outcomes and the strength of the connections were the foci of our analysis. It

was important that the professors grasped what was expected from the course in its current state (2005). A clearer focus on the knowledge content and its breakout of major, secondary, and minor content and the priority of those content clusters were our first tasks in the analysis process. The professors completed the outlines and identified the inherent mathematics, science, and communication foundation knowledge and skills expected of students upon entering the course. This was one milestone in the analysis process.
(NIU General Education Goals- http://www3.niu.edu/provost2/facpers/appm/IIID,1.htm).

Course Knowledge Source
Finally, the professors identified the knowledge content sources as the text, themselves, manuals, tutorials, field, speakers, literature, etc. This analysis led them to understand they relied much too heavily on the textbook, and in some cases where they were the source, they determined they were not really using their expertise as well as it could be used. Almost no external sources were used for knowledge content (e.g., field, literature, case studies) (Bloom, 1956).

Teaching Models, Styles and Student Learning Styles (Portfolio Component Section B5)
Following the outlining of the course content knowledge, the determination of content priority, the math, science, communication, and source analyses, each professor focused on what teaching models and teaching styles were primarily used and then what student learning styles they felt students had the opportunity to engage in throughout the course. Each professor considered his/her course content and identified the teaching models, styles, and student learning styles he/she believed best described what occurred during the teaching and learning process throughout their courses. To guide them in this process, a list of teaching models, teaching styles, and learning styles, followed by brief definitions, descriptions, or explanations were provided. In some cases, two versions were provided; for example, both Kolb and Felder learning styles were presented. They quickly discovered their courses were primarily lecture based, although there were learning events throughout most of the courses during which the inquiry, training, simulation, and other models were used, just not often enough. Clearly, they discovered a need to diversify the teaching models used throughout the courses as well as a need to diversify styles. The same trend was obvious when considering what learning styles they felt their teaching made possible for students. Although there were particular learning events where students could use a variety of learning styles, the professors discovered they generally taught in a way that limited student learning style diversification and the ability for students to expand their comfort zone across multiple learning styles.

Professors had not designed their instruction or courses to intentionally use a variety of teaching models and styles or to engage students across the range of learning styles. Therefore, they were possibly preventing some students from learning as well as might have been possible with a broader range of learning style opportunities (Anderson & Krathwohl, 2001; Bloom, 1956; Dale, 1969; Felder, 1988; Grasha, 1996; Joyce, Weil, & Calhoun, 2004; Kolb, 1984; Mosston & Ashworth, 1990). Generally, there was a clear need to diversify teaching models and styles so students could use their primary learning style while also expanding to become comfortable with other learning styles.

Knowledge Content Considered by Bloom's Taxonomy and Dale's Cone of Learning (Portfolio Course Analysis Section B5)

The analysis process continued with Dale's Cone of Learning to determine the range of passive versus active learning and Bloom's traditional and revised Taxonomies of Learning (professor's choice) – the Cognitive Process Dimension – to determine how often students were provided the opportunity to engage in higher levels of cognitive processes and critical thinking while learning (or were they just memorizing?). This led the professors to consider the level of critical thinking stimulated by their teaching or required in course activities and, finally, to determine whether they thought their course was teacher, knowledge, assessment, or learner centered. We provided simple handouts with definitions, descriptions, or examples to become familiar with Bloom and Dale's models, using the models as metrics to analyze the courses. Questions or more explanation was provided when requested or needed. Although this might be perceived by readers as a superficial analysis (and in some ways it was), it worked very well to stimulate the professors to an awareness level of where student learning was on Bloom's Cognitive Process Dimension, whether students were actively or passively engaged, whether they were requiring critical thinking, and to what level, their courses were teacher, knowledge, assessment, or learner centered. As they redeveloped their courses, a deeper understanding occurred as a result of their use of Bloom and Dale models as a basis for course design (Anderson, Cruikshank, Mayer, Pintrich, Raths, & Wittrock, 2001; Bloom, 1956; Dale, 1964; Nosich, 2005).

> <u>Dale's Cone of Learning</u> was used as a simple and informal guide to which they could compare and consider the level of active versus passive learning occurring in the courses of focus. Then they could determine where they needed to make the student learning more active. They found their courses to be mostly passive; some had more active segments, but generally, most of the learning was taking place passively by students.
>
> <u>Bloom's Taxonomy of Learning</u> (traditional or revised) – the Cognitive Process Dimension - was used also as a guide from which to judge the critical thinking and levels of cognitive processing students were achieving in the courses. During this analysis, the professors varied in their self-reported judgments of the level of learning occurring by their students. Some reported that the course and student learning were mostly at the lower end of Bloom's Taxonomy, regardless of which version was used. Others reported that students were learning at the upper levels of Bloom's; however, in examining and analyzing the course content, assessments, learning activities, they relied mostly on mathematically-oriented problem solving with no rubrics or criteria available to guide or score performance. The problems were poorly structured, grading was very suspicious and far too subjective, and there were too few opportunities for students to provide evidence of learning and too few methods to provide students with opportunities to show evidence of learning. So the professors' self-reported responses and lack of awareness of what higher levels of cognitive process really entailed resulted in somewhat biased and uninformed analyses. However, this was an excellent method for them to learn about the higher levels of cognitive processes they could achieve with their students. There were two professors who possibly had some significant higher levels of learning occurring, but not

formally structured, based upon a review of the course materials. And, although this was true, when formalized, their courses and potential student learning were strengthened greatly.

Critical thinking was subjectively addressed by continuing from the Bloom's analysis to judging whether the professors thought critical thinking was evident at the low, medium, or high ranges in their courses or student learning. Two professors did not complete this component, and their Bloom's analysis would have revealed that not much critical thinking was occurring. The others reported a range of 1 – 4, with 5 being very high (or low to high). However, once again, in reviewing their courses, assessments, and learning activities, this self-report was biased towards the higher ends. The analyses provided evidence that, with some exceptions, there were mostly lower levels of critical thinking being required of their students.

The professors considered what their courses were centered on and judged them to be teacher centered, knowledge centered, assessment or student centered. In other words, the burden of learning was on the teacher, not on the students where it should be, and the assessments were poor. They realized that they needed to create their re-developed courses so the "centeredness" shifted appropriately, where there would be overlap or integration of the four types of "centeredness" (teacher, knowledge, assessment, learner) but also to design their courses to be primarily learner centered.

The course analysis revealed that professors needed to formally design learning so it was more active and required students to engage at the higher levels of Bloom's Cognitive Process Dimensions and critical thinking. The process also revealed that professors needed to develop clear criteria for student performance and for judging evidence of learning and that what was to occur in the course and student learning was intentional (what the professors had clearly determined as important to learn) and could be supported by formal evidence of student learning. (Anderson & Krathwohl, 2001; Bloom, 1956; Dale, 1969; Frye et al., 2003; Kolb, 1984; Nosich, 2005). The following worksheet was used as a tool to organize the initial analysis.

Table A.5.4: Content Schedule and Teaching Models, Styles, and Bloom's Analysis

Week	Content Topic: Bloom's Knowledge Dimension Factual, Conceptual, Procedural, Meta-cognitive	Content Source Text, Professor, Field, Literature, Speaker, DVD, etc.	Teaching Style a-k	Teaching Model 1-24 name	Kolb Learning Style CE, AE, AC, RO	Dale's Cone Active or Passive	Bloom's Cognitive Process Dimension Traditional: Evaluation, Synthesis, Analysis, Application, Comprehension Knowledge	Bloom's Cognitive Revised: Create, Evaluate, Analyze, Apply, Under stand, Remember	Critical Thinking Low Medium High	Centered? *Teacher, Knowledge Assessment, Learner*
1										
2										

Note: a two or three day/week form was used. (See Section C1 for worksheet)

Gaps Analysis Summary (See Portfolio component)
This analysis stemmed from the content analysis and teaching/learning analyses above; the form was an attempt to summarize what they had observed about their 2005 courses and teaching practices so they could better view the whole picture. In addition, it led them to an analysis of whether they felt the ABET(EAC/TAC)/NAIT outcomes were being achieved from the perspective of their course outlines or knowledge content and priority lists. They simply, once again, reviewed their course outlines and general education expectations from the above analyses to determine how well the ABET(EAC/TAC)/NAIT outcomes were being covered. Then they reviewed their 2005 student learning objectives from the perspective of teaching models, styles, learning styles, Bloom's Knowledge and Cognitive Dimensions, and Dale's Cone of Learning. The professors used the notations of "√" or "C" on the form to identify whether they felt they were "okay" or needed to "consider" changing something or trying a new method. This worksheet was somewhat duplicative but added analysis of the course objectives or student learning outcomes and provided a more complete picture – one that was more useful as it clearly revealed what professors needed to consider addressing when redeveloping their 2005 courses and making instructional decisions for the redeveloped 2006 courses. Clearly, the GAPS between where they were, the "current reality" of the 2005 courses, and what they could move towards, "their vision" for the 2006 courses, were revealed. The following worksheets were used to organize and summarize the teaching and learning factors described above.

Once the GAPS Analysis Summary was completed and the professors continued on to the course redevelopment program component at a later point in the program, another more integrated form was used where the ABET(EAC/TAC)/NAIT Outcomes are listed in the left column. The General Education Goals are shown embedded in each outcome, a more integrated format. That format is shown later.

Table A.5.5: GAPS Analysis Summary (See Portfolio Section B.5 – Report and Faculty Examples)

NOTE: Each faculty member chose which Standards or Outcomes form below to use depending upon whether they were accredited by ABET Engineering, ABET/ EAC/TAC for Engineering Technology, or NAIT for Technology. Our college has all three accreditations. ABET/EAC/TAC and NAIT have been merged for use by the Department of Technology with both Engineering Technology and Technology programs. Legal size paper works best for workshop use. (See Section C1 for worksheet)

GAPS Analysis Summary: ABET-Engineering Outcomes

a. apply math, science, engineer-ing	b. design/ conduct experi-ments; analyze, interpret data	c. design system, compo-nent, process-given constrain ts, etc.	d. function on interdis-ciplinary teams	e. identify, formulate, solve engi-neering problems	f. understand professional, ethical responsibility	g. ability to communicate effectively	h. understand impact of engineering Solve global economic, environmental, issues for society	i. recognition of need for, and ability to engage in life-long learning	j. Knowledge in contem-porary issues	k. ability to use techniques, skills, and modern engineering tools
Professors	identify	St. L. Outcome	for each	standard.	Those that	are not	addressed	by the course	are left blank.	

GAPS Analysis Summary: ABET(EAC/TAC)/NAIT-Engineering Technology and Industrial Technology Outcomes

a. mastery of know-ledge, tech-niques, skills, modern tools	b. ability to apply current know-ledge; adapt to emerging applica-tions of math, science, techno-logy	c. ability to conduct, analyze, interpret experi-ments; apply experi-mental results to improve processes	d. ability to apply creat-ivity in design of systems, compo-nents, processes	E. ability to function effect-tively on teams	f. ability to identify, analyze, solve technical problems	g. ability to com-municate effect-tively writing	h. ability to commu-nicate effect-tively orally	i. recognize need for, ability to engage in lifelong learning	j. ability to under-stand profess-sional, ethical, social respon-sibilities	k. respect for diversity; knowledge of contem-porary profess-sional, societal, global issues	l. commit to quality, timeliness, continuous improve-ment	m. ability to program computers and/or use computer applications effectively	n. →q. ability to use modern laboratory techniques, skills, equipment effectively Refer to ABET(EAC /TAC)/NAI T for o,p,q
Profs	identify	SL Outcomes	for each	standard.	Those	that are	not	addressed	by the	course	are	left	blank.

GAPS Analysis Summary: NIU General Education Goals

St. L. Outcome	Writing	Speaking	Listening	Quantitative Reasoning	Use of Resources-Technology	His/herstorical Development Of Culture	Significance of Arts	Cultural Traditions; Philosophical Ideas	Methods in Science Methods in Social Science	Interrelatedness Across Disciplines	Social Responsi-bility
Professors	respond	on	following	rows.		Each learning	outcome	Vertically	is addressed	for each column.	

Table A.5.5: GAPS Analysis Summary (continued)

Note: The student learning outcomes by teaching model worksheet below is laid out in one row on a legal sized form so that student learning outcomes can be listed in far left column and then which teaching models used checked off horizontally for each outcome. Parts 1 and 2 for Models fit on legal sized paper.

Student Learning Objectives/Outcomes & Teaching Models (Part 1)

St. L. Outcome	Memory	Progressive Part	Advanced Organizer	Lecture	Reciprocal Teaching	Mastery Learning	Cooperative Learning	Graphic Organizers	Concept Attainment	Synectic	Psycho-motor	Meta-phore
Professors	respond	on	following	rows.	Each	learning	outcome	vertically	is addressed	for	each	column.

Student Learning Objectives/Outcomes & Teaching Models (Part 2)

St. L. Outcome	Concept Formation	Concept Presentation	Conceptual	Induction	Deduction	Inquiry	Simulate	Jurisprudential	Direct Instruction	Training	Non-direct	Role
Professors	respond	on	following	rows.	Each	learning	outcome	Vertically	is addressed	for	each	Column

Student Learning Objectives/Outcomes & Teaching Styles

St. L. Outcomes	Command	Practice	Reciprocal	Self-Check	Inclusion	Guided Discovery	Convergent Discovery	Divergent Production	Learner Designed	Learner Initiated	Self Teaching
Professors	respond	On	following	rows.	Each	learning	outcome	vertically is	addressed	for each	column.

Student Learning Objectives/Outcomes & Kolb's Learning Styles

St. L. Outcomes	Concrete Experience	Abstract Conceptualization	Active Experimentation	Reflective Observation
Professors respond on following rows.	Each learning outcome	vertically is addressed	for each column.	

Student Learning Objectives/Outcomes & Bloom's Taxonomy – Cognitive Dimensions & Dale's Cone

St. L. Outcomes	Dale's Cone Levels P A A+	Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Create	Critical Thinking Level L M H
Professors respond on following	Rows.	Each learning	Outcome	vertically	is addressed	for each	column.	

(Scarborough, 2006)

Instructional Design GAPS Analysis
Although similar or slightly redundant but adding pieces to analyze, the following form and process moved the professors forward to include and analyze their student <u>assessments</u> beside the student learning outcomes and against Bloom's Cognitive Dimension and Dale's Cone of Learning. This aspect of the process was used to engage them in identifying or matching the student assessments, mostly tests for the 2005 course, to the student learning outcomes. This process engaged them in connecting the knowledge content they felt they were teaching to their tests or other assessments and revealed more clearly what the professors were actually testing or measuring. Linking tests and test items directly to outcomes informed the professors whether they were testing what they thought was being tested. The relationship between what is taught and what is tested has long been a problem in courses or classrooms, even for experienced education professionals. Are we really testing what we think we are? A complaint often heard from students is that the professors did not cover what was on the test, that they did not test what they said they were going to, or that the tests did not correspond with course content being taught – from the students' perspective. This particular process also asked the professors to repeat by outcomes, Bloom and Dale abbreviated, and the knowledge content sources (e.g., text, professor, etc.). The reason for the abbreviated repetition was so the linking would flow logically and serve as a check and balance. It is helpful when professors also identify the source of the content for the tests and test items or other assessments. That is how the GAPS are identified and how the missing links between what is being taught and tested are revealed. If content cannot be mapped directly to assessments, to tests and test items, or to performances and criteria on the rubrics, then a gap or missing link reveals itself. This is truly illuminating for professors. Mapping is a great process for this and many other analyses.

As we progressed through the analysis process, the overlap (or intended redundancies) gradually resulted in greater familiarity and understanding of the models, styles, outcomes, and instructional issues. As we progressed, we were adding factors for consideration. The professors gradually realize that teaching and learning are complex constructs, yet small changes can make great differences. This expands and deepens understanding gradually.

Finally, this program component asked them to consider where they thought their tests and test items were on Bloom's Cognitive Dimension and Dale's Cone and revealed where they needed to make changes so students could better achieve learning at the higher cognitive levels and in more active ways (even on traditional tests). It is important to ensure that tests or assessments are also achieving higher cognitive dimensions and are as active as possible. Although a few professors' analyses revealed learning to be intermittently at higher levels of learning on Bloom's and more active on Dale's, there were many opportunities to improve. There were no formal structures and grading criteria (rubrics), and the relationships or links between objectives or student learning outcomes, tests, and test items were unclear and often weak. This form and process also asked them to analyze any non-test assessments, (e.g., projects, performances). A few professors required projects of the students, but the grading was very subjective with no established criteria or rubrics. Also there were no formal performance tasks identifying what students were expected to do. As is typical in many courses, a project topic was provided and then students or student groups took it from there. Also missing were any criteria, expectations, or consideration of how to grade team work.

Team work was not formally set up so individual and group learning accountability was accomplished. Thus, the objective/outcome-to-test-and-item matching (the assessment, tests and projects measured against Bloom's Cognitive Dimension and Dale's Cone) revealed many opportunities to strengthen the quality and connections of assessments. Clearly, the professors needed to move toward an assessment plan that was more multifaceted if they were to create a broader range of opportunities for students to provide evidence of learning that corresponded with a broader range of learning styles and performance styles (Bloom, 1956; Johnson & Johnson, 1998). The following worksheet was used to organize this analysis.

Table A.5.6: Instructional Design GAPs Analysis - Connecting learning outcomes to assessments (See Portfolio C1 for worksheets)

ABET Outcome a-k ENG ABET/ TAC/ NAIT Standard A-Q Tech	Student Learning Outcome (s) listed on syllabus	Bloom/Dale *Evaluation/ Active Synthesis/ Active Analysis/ Active Application/ Active Comprehen-sion/Passive Knowledge/ Passive*	Knowledge Sources Professor, Text, Cases, Field, Literature Speaker, References, etc.	Student Assessments listed on syllabus	Bloom/Dale *Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive*	Tests and Items	Bloom/Dale *Evaluation/A Synthesis/A Analysis/A Application/A Comprehension /P Knowledge/P*	Performance If Any; If none, leave blank	Bloom/ Dale *Evaluation/ Active Synthesis/ Active Analysis/ Active Application/ Active Compre-hension /Passive Knowledge/ Passive*

Test Analysis

Once the overall analysis of the quality of the tests and/or other student assessments regarding the connections to the student learning outcomes was completed, we then formally analyzed their "current" 2005 tests. In reviewing the existing tests/exams for their courses, as expected there was a wide variety of test types. Most tests involved problem solving rather than totally objective items; some had multiple choice items involving problems that had to be solved before choosing a response; and some had word problems where formulas had to be chosen and then solved. Some tests were in-class, while others were take home tests. Some tests included open-ended problems, not prompted with responses, and some were open-ended, short answer items. The assessments, mostly tests, were not "problem based." The literature establishes a difference in problem based learning versus problem solving. Problem based learning, which can also be an assessment, is more open ended; the answers or responses are not predetermined as didactic. Typically, problem solving engages the student in solving a problem for which the professor is expecting a particular or predetermined answer. Regarding quality, the range was varied across professors and within and across the tests. It is clear that the professors were trying to engage students in problem solving rather than memorization for the most part. That was positive. The quality of items ranged both within any single test and across the tests as well. Although various grading procedures were used, the grading was very subjective for the open-ended and problem solving items. There were no rubrics or criteria to use when judging student solutions. Therefore, awarding partial points for an overall incorrect item was subjective and not perceived as consistent across student tests. The professors' discussion of grading procedures

led us to believe that it was very important for them to analyze their grading procedures and structure. They needed to identify definitive criteria, structure, and formal reasoning for giving points and then confirm that they must stick to their grading procedures once established. The discussion was very interesting with all aspects of arguments, some valid, some definitely not valid, especially those related to "curving" grades. We had to dispel myths about the benefits and inappropriateness of "curving" grades (Anderson & Speck, 1998; Dominowski, 2001; Frye, 1994; Royse, 2001; About Grades, n.d.).

An important aspect of this program component was the week devoted to test analysis and test development. The professors learned how to analyze tests using their current tests where possible; however, when that was not possible, because tests were problem based and not objective, then they were provided a (real test) case for the learning process. Each professor learned to analyze objective tests. This performance-based learning process was the introduction to the development of good or improved objective tests. Each professor learned the purpose of item analysis and the factors affecting item statistics, and then engaged in analyzing for item difficulty and item discrimination. They discussed the "flagged" items and made decisions about how to address them. They considered the validity, reliability, and standard error of measurement regarding the tests analyzed and ended the analysis sessions with a better understanding of what caused tests to be of higher or lesser quality. Ultimately, they realized that test analysis serves as a diagnostic tool for the ongoing quality improvements of tests and instruction. Finally, they were introduced to NIU's Testing Services and what that service could offer them. This session segued into new test development (Nitko, 2004). See the full Report on Tests in Section B6.

Course Analysis Completion

The test analysis program component ended the 2005 course analysis segment of the faculty development program. However, it did not end the process of analysis. Professors continued to be analytical throughout the critical reflection process, thus becoming more intimate with the inherent process of "Reflective Practice," a foundation for the Scholarship of Teaching and our faculty development program.

2006 Course Development
(2005 Course Redevelopment)

The course redevelopment process was based upon the 2005 course analysis results described above and reported in the college portfolio results section – B5 and B6. Each professor identified changes to make in the redeveloped course based on what was learned through the above analyses. In beginning the formal redevelopment of their 2005 courses and in using the Reversed Design and our Intentional Model, they began with the identification of the student learning outcomes and connecting to the ABET and NAIT outcomes. This was followed by the development of new tests with both objective and problem solving items; development of new and formal performance tasks and corresponding rubrics; scoring the grading procedures. Those were followed by making instructional decisions about teaching models, styles, and student learning styles and culminated in the redevelopment of the course syllabus and making other instructional decisions. Each is described below.

Student Learning Outcomes Development

Learning Objective or Outcomes Analysis (See Portfolio – Section B7 and PowerPoint Presentation – Section D3)

From this point in the program, the focus was development or “redevelopment” of the selected 2005 courses. The courses were considered from the perspectives of what was learned during the analyses performed above; professors identified changes that were important. The identified options can be noted in the GAPS Summary described above (B5) or when reading the Portfolio summary, where professors use C to note consideration of models, styles, etc. This program component was also where we began to formally use the “Reversed” instructional design. Professors were to intentionally: (1) determine what they wanted students to be able to know about or do upon completing their course and (2) determine what evidence of learning was acceptable to confirm student learning. All other instructional decisions follow response to these two primary questions when using the “reversed and intentional” instructional design process (Dick & Carey, 1996; Wiggins & McTighe, 1995, 2005; Scarborough, 2006).

This led us to the first stage of the 2005 course redevelopment(s). From this point forward, the course will be identified as the 2006 course. We used a worksheet that was designed so all ABET(EAC/TAC)/NAIT Learning Outcomes were listed for the professors. Beneath each standard or outcome, the embedded general education goals were also provided, and beside that column, Bloom’s Knowledge Dimensions were listed so professors could determine which dimension best identified the knowledge content of their courses. Also there were columns for identifying which of Bloom’s Cognitive Dimensions each outcome would achieve. Finally, a column was included to indicate Dale’s level of active versus passive learning that was expected to occur. Each professor then redeveloped the student learning outcomes. If an outcome was complex, representing a cluster of knowledge concepts or multiple knowledge dimensions, then they were to state these appropriately and break them out, also aligning each one beside the corresponding ABET or NAIT standard or outcome and showing the embedded general education knowledge expectations. In case an outcome addressed only a partial aspect of the national outcomes or where there were partial aspects of the NIU general education goals expected, then they used the highlight to identify them. (Note an example on the form below.) This program component engaged the professors in a way that revealed how much they had learned. They were using better language for the outcomes, terminology that was active, measurable, and more specific; breaking the outcomes into second and third levels helped the professors to be more specific – more clearly revealing what was important to learn. It was much easier to determine Bloom’s Cognitive Dimensions because the outcomes were written more explicitly and broken out if complex clusters. This was the first product for their revised 2006 courses. What they wanted students to know about or be able do upon completing their course was answered. The terms “intentional and reversed” are critical to us. We realize that some professors have the gift of accomplishing something good and worthwhile in their classrooms whether fully planned or not; however, we are determined that what is learned should be intentional, planned, and formal in nature. This does not dismiss the benefit of the informal learning or extensions that normally occur beside the formal and intentional components. Completing this activity led us to the second aspect of development; using the “reversed” instructional design process,

faculty designed and developed the student assessments, or the tools, processes, and procedures to collect evidence of learning.

The following chart (blank) presents ABET Engineering outcomes A, …H,I,J,K just to present the worksheet. The complete worksheet includes all Engineering Outcomes A-K, and the embedded NIU General Education Goals, Bloom's Knowledge and Cognitive Dimensions, and Dale's Cone. A second version of the form was used for the ABET(EAC/TAC)/NAIT standards and outcomes for the professors teaching in the engineering technology and technology programs. Selected outcomes are shown below; once again, the professors used a form that presented all outcomes. Professors added their individual course student learning outcomes aligning them with the national outcomes. The stars identify levels of Bloom's accomplished on the Cognitive Dimension; checks (√) indicate the Knowledge Dimensions. (This provides a view of what a completed form visually presents.) It is important to remind ourselves that professors sometimes do not realize it is not their responsibility to address every national outcome in every course, but instead their courses contribute to the total of all program outcomes required by the accreditation agencies.

Each version (ABET Engineering and ABET(EAC/TAC)/NAIT) of the worksheet completely presented the national standards or outcomes with embedded NIU General Education Goals. Each professor completed one of these worksheets for the 2006 course he/she was redeveloping. The form clearly presented what outcomes were and were not addressed by each course; it identified the embedded general education knowledge or inherent/embedded mathematics, science, and communication expected of students. Then the form revealed Bloom's Cognitive and Knowledge dimensions so professors could determine where they needed to increase learning to higher levels or check to validate or improve the knowledge content. The Knowledge dimension assisted professors in examining their knowledge content more deeply than topical outlines while also focusing on the source of knowledge, and Dale's Cone reminded them to keep learning active and of high integrity. Now our professors understand that their courses contribute to the overall program outcomes and that they should be clear about which ones they attain in depth, and so on. Our college uses a metric for that purpose, but even so, we needed to revisit that point so the courses became more focused and realistic about what could be accomplished well. Table 7 presents a blank form for the engineering program; Table 8 presents the form for engineering technology and technology. It is completed so the reader can see what occurs. See Portfolio Section B7 for the complete example and Section C1 for blank worksheets.

Table A.5.7: ABET Engineering Outcomes Worksheet (See Portfolio C1 for worksheets)

ABET Engineering Outcomes **Partial list of outcomes. A….H, I, J, K	Bloom's Knowledge Dimension	Dale's Cone Passive/ Active	Student Learning Outcome	Bloom's Cognitive Process Dimensions – Traditional and Revised					
				Knowledge Remember	Compre-hension Under-stand	Application Apply	Analysis Analyze	Synthesis Evaluate	Create Evaluate
A. apply knowledge of math, science, engineering **NIU Gen Ed Goals - *Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem***	Factual Conceptual Procedural Meta-Cognitive								
H. understand impact of engineering solutions in a global economic, environ-mental, societal context **NIU Gen Ed Goals - Students: *d. develop social responsibility and preparation for citizenship through global awareness, environmental***	Factual Conceptual Procedural Meta-Cognitive								
I. recognize the need for, and have capability to engage in lifelong learning. **NIU Gen Ed Goals - Students: a.iv. *are able to access and use various information sources. Internet, text, field***	Factual Conceptual Procedural Meta-Cognitive								
J. knowledge of contemporary issues **NIU Gen Ed Goals - Students: *d. develop social responsibility and prepare for citizenship through global awareness, environ-mental sensitivity, and an appreciation of cultural diversity.***	Factual Conceptual Procedural Meta-Cognitive								
K. use techniques, skills, and modern engineering tools necessary for engineering practice	Factual Conceptual Procedural Meta-Cognitive								

To present a completed section, below is the merged ABET/TAC and NAIT worksheet for the Department of Technology's Engineering Technology and Technology programs (Tech 496). This is a partially completed form.

Table A.5.8: CEET's 496 Course (See Portfolio for complete form B7 and C1 for worksheet)

ABET(EAC/TAC)/NAIT Engineering & Technology Outcomes **Partial list of outcomes.	Bloom's Knowledge Dimension √ = Yes	Dale's Cone Active Partici. Passive	Student Learning Outcome	Bloom's Knowledge Dimensions Note: CT = Critical Thinking high √= good !=very good ★ =excellent					
				Knowledge Remember	Comprehension Understand	Appli-cation Apply	Analysis Analyze	Synthesis Evaluate	Create Evaluate
A. Mastery of knowledge, techniques, skills, modern tools of disciplines.	√Factual √Concep-tual √Procedural √Meta-Cognitive	**Highly Active**	**6.To demonstrate effective project:** **a. planning** **b. initiation** **c. execution** **d. termination**	√	√	! **CT**	! **CT**	! **CT**	★ **CT**
B. Apply current knowledge and adapt to emerging applications of math, science, engineering, and technology. **NIU Gen Ed Goals -*Students:*** ***a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical infor..***	√Factual Knowledge √Concep-tual Knowledge √Procedural Knowledge √Meta-Cognitive Knowledge	**Highly Active**	**8. To integrate mathematics, the sciences, communi-cation, management, technical, and technological knowledge and skills; to accomplish team and project objectives.**	√	√	! **CT**	! **CT**	! **CT**	★ **CT**
D. Ability to apply creativity in the design of systems, components, or processes appropriate to program objectives. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems, issues.***	√Factual Knowledge √Concep-tual Knowledge √Procedural Knowledge √Meta-Cognitive Knowledge	**Highly Active**	**8. To integrate mathematics, the sciences, communica-tion, manage-ment, technical, knowledge & project objectives** **a. design a vehicle to technical specifications** **b.build the vehicle to techninical specifications** **c.solve tech problems associated with deisgn, construction, and evaluation** **d.test/evaluate vehicle against tech. specs.**	√	√	! **CT**	! **CT**	! **CT**	★ **CT**

(Scarborough, 2006 incorporating ABET and NAIT with NIU)

The following outline served as a worksheet to prepare student learning outcomes for the form above and/or to serve as a graphic organizer or format so professors could begin to visualize and broadly link outcomes and assessments. Some professors outlined their student learning outcomes before transferring them to the worksheet above using this form; others worked directly on the worksheet above. Either way professors

began to more deeply understand that everything must be logically connected, clearly linked and mapped. The worksheet revealed the broader link between outcomes and assessments, itemizing outcomes to assessments (e.g., tests or performance tasks) and then to specific test items or rubric criteria.

Table A.5.9: Tech 496 Industrial Project Management

Students will be able to: Student Learning Objectives and Outcomes	**Corresponding Assessments:**
1. Identify and describe major problems, issues, concerns, and solutions that relate to projects, project management, project teams, and project leaders: Identify problems, issues, concerns, and solutions (PICS) that: a. occur during projects b. relate to project management c. occur during team engagement on projects between team members and/or team leaders d. occur for team leaders of projects e. are specific to international projects f. occur during projects that are executed by a multi-cultural teams and involve ethnically diverse team members working together g. are specific to team leaders of international projects and/or multicultural teams executing projects	Text Project Literature Study Paper Case Study Career Project Team Project
2. Identify and describe best practices for managing projects and leading teams, including international projects and multi-cultural teams.	Literature Study; Text Project Case Study; Paper, Team Project
3. Perform effectively on a project team (hopefully multicultural team) to complete a technical project. a. To engage in conflict resolution to resolve team issues. b. To perform team and peer assessments throughout the project c. To execute a technical project	Team Participation Assessment Team Assessment Professor's Assessment Team Project Outcomes
4. Prepare the team for project work by: a. developing a team operations manual b. developing a peer and team assessment system c. creating the team organization and process d. developing an individual project plan e. participating in the development of a team project plan	Team Operating Manual Peer Assessment System Use of Peer Assessment System Team Plan
5. Exhibit leadership and/or participation while engaged in a team community service project. a. plan ; b. initiate ; c. execute; d. terminate	Service Project Report & Evaluation
6. Demonstrate effective project: a. planning; b. initiation; c. execution; d. evaluation; e. termination; f. problem solving; g. leadership	Individual Project Plan; Individual Portfolio Peer Assessment; Team Assessment Team Participation- Assessment-Project feedback Team Project Plan; Team Portfolio Team presentation, Website
7. Demonstrate effective use of project management techniques and tools in the management of a technical project. a. plan; b. initiation; c. execution; d. termination; e. evaluation f. MS Project; g. finance procedures; h. SWOT Analysis; i. procurement procedures j. scheduling k. MACE procedures and process; l. project evaluation	Individual Project Plan MS Project Test Individual Portfolio Peer Assessment Team Assessment Team Plan Team presentation, portfolio, and website
8. To integrate mathematics, the sciences, communication, management, technical, technological knowledge and skills to accomplish team and project objectives. a. design a vehicle to technical specifications; b. build the vehicle to technical specifications; c. solve technical problems associated with design, construction, and evaluation specifications	Project Plan Vehicle Design Specifications Project Evaluation Procedures Executive Presentation Project/Team Website Team Portfolio Vehicle Operations Manual

Student Assessment
(See PowerPoint Presentation – D4)

Test Development
The test development program component was based on the new student learning outcomes for each course and the levels of Bloom's Cognitive Dimensions that each professor desired to achieve with his/her students for assessments; therefore, the professors created a Table of Specifications based upon Bloom's Taxonomy and/or any other specifications they individually desired. They considered the validity of test items; why to use many discrete, objectively scored items; and how to construct multiple choice, items, short answer, and true/false items. They began to understand that the learning outcomes prioritized as primary were those that also needed to be more thoroughly reflected in test content and items, that the secondary items were to be well represented on tests as well, and that many of the second and third level or "other" outcomes could not be minimally, if at all, reflected in test content or items. The professors also learned to consider test development from a time factor perspective, as well as from the perspective of what is important to measure, and to realize that not everything can be tested in a single test time-period of one-hour duration. The professors began to understand it is important to develop a test with a variety of item types. To reinforce this during the item development process, they were asked to create multiple questions of different types for each student learning outcome for the entire course, thus developing a test item bank. This would also prepare them to be able to retest something on the final exam that had been on the midterm but with a different question. A very important discussion that occurred was about "easy" items. The professors revealed great concern about making students comfortable by including some intentionally easy questions that all students would answer correctly, thereby receiving those points. We understood their motive and goal but tried to convince them that it was better to focus on the development of well designed and constructed items that were clear, had integrity, were directly linked to what was taught, and provided well rounded opportunities for students to show evidence of learning (e.g., varied item types, etc.). Once they completed item development, they then assembled their tests: one comprehensive midterm examination and one comprehensive final examination. If professors desired to have non-objective, open-ended problems, that was fine; however, the non-objective questions were arranged on the tests such that the analysis procedures were not affected by those items on the answer sheets. The tests were reviewed and feedback was provided to each professor. Professors were asked to revise their tests based upon the feedback by the program component leader. These tests were then administered as the midterm and final exams for the course during the 2006 experimental research semester that followed. Each professor then engaged in test analysis to determine the strengths and weaknesses of the tests, which reinforced the actual on-going use of test analysis for diagnostic purposes. They prepared an informal diagnostic write up describing how the analyses were to be used diagnostically to improve tests and instruction in the future.[3]

[3] Recall that the professors learned how to perform test analyses on their 2005 tests during the test analysis program component earlier (e.g., item analysis, item statistics, item difficulty and discrimination) using a Table of Specifications, etc.

It might be important to understand several points of discussion. We discussed validity and reliability but did not go deeper into those topics. We also discussed how to externally validate the tests using external field-based engineers and technologists, a process that can validate the content and its application. Also we discussed using peers to validate that the tests are measuring what is intended. Finally, one of the most important considerations - how does one interpret what a student knows or can actually "do" using tests. We discussed the philosophy that "typical" tests only reveal what students might <u>know</u> <u>about</u>, not what they can <u>actually</u> <u>do</u> (Linn & Baker, 1996 as cited in National Society for the Study of Education - NSSE). Test results, unless developed well to the point of requiring higher cognitive levels of performance, serve only as <u>indicators</u> of what students might be able to do or perform – valued real world performances. We understand that if the test items are written to achieve the higher levels of Bloom's cognitive process dimensions, they can in fact reflect what students can do, e.g., problem solving. We used the "tests are usually useful only" as "indicators of valued 'real-world' performances" as stimulus to segue into the need to include performance assessments to measure student learning (p. 85). Furthermore, we established that the professors had very limited assessment plans for their courses. Although there were some projects, these were not formally structured and had no formal grading criteria or rubrics. Both students and professors are at a distinct disadvantage when there is little to no structure or few to no grading criteria to make clear what is expected on performances, how assessments will be graded and counted in the overall course, and to prevent ambiguous and inconsistent grading by the professor. Therefore, it quickly became apparent that a more multifaceted and balanced assessment plan was needed for each course, where formal performance tasks and rubrics would benefit the students and course knowledge attainment as well as provide a greater range of tools or procedures with which students could provide evidence of learning. Therefore, we considered tests at the lower levels of Bloom's cognitive dimensions to serve only as indicators of what students can actually do; of course, tests that do achieve upper levels of Bloom's may reveal more. This led us to consider how to broaden the assessment plans for each course to include performance tasks and rubrics for projects or performances that would extend what could be determined about student attainment of knowledge in the courses. We also encouraged professors to expand their assessment plans beyond tests and performance tasks so students would experience even more and varied opportunities to provide evidence of what they learned. The feedback from the professors on the value of learning how to analyze and develop tests was extremely positive. (Kuhs et al., 2001; Nitko, 2004). (See Tests Section – B6)

Outcomes by Test and Items Analysis (See Sections B8 and C1)
Once the 2006 tests were developed, we engaged the professors in another analysis using a worksheet to stimulate and reinforce the "Intentional" and "Reversed" instructional design process. As described above, professors were first asked to determine what they wanted students to be able to know about or do upon leaving their course and then what evidence of learning would be acceptable. We required the professors to develop objective midterm and final exams, even if they preferred problem solving and non-objective items, because we felt they needed to learn how to develop tests with higher integrity. We also required them to design and develop three complex performance tasks with clusters of performances embedded within the "real-world" tasks and the corresponding rubrics with standards of

performance and criteria for each. We asked them to overlap or connect, both the midterm and final exam, to a performance task. Finally, we asked them to develop a third performance task and use it anywhere within the course content or schedule. Our purpose in doing that was to have them realize that knowledge varies and how it can best be measured also varies. Some knowledge can be measured well by both tests and performances; some to traditional tests; while other knowledge is best measured by performances. Also some content can be measured more deeply if first tested, perhaps somewhat superficially, and then through performances. Overlapping testing and performance assessment is sometimes beneficial. But clearly the professors needed to consider the relationship between traditional tests and performances and what they could accomplish as measurement tools for determining what students learned and to what level they have learned the knowledge or skill. Finally, it was important for the professors to realize that students vary in their ability to reveal what they have learned and need a variety of opportunities to best provide evidence of learning. To us, the best courses are those with many and varied types of opportunities for students to show the professor what they have learned. Most professors in our program learned that they were too limited in the breadth, depth, and number of assessments required throughout the course and that their assessments were not integrated into the learning process but were instead artificially separated. We prefer “assessment as learning,” where students self-monitor and self-correct or make adjustments while learning, and providing evidence of learning. We realize that assessment of learning, where the teacher or other students are the reference points or assessors, and that assessment for learning is critical for measuring achievement of the external standards of our accrediting agencies are all important. However, we advocate that “assessment as learning” is critical and most beneficial for students while enrolled in our courses, and especially toward life-long learning (Marzano et al., 1993; Scarborough, 2004, Chapter 12; Wiggins, 1998).

This is where we began to more deeply consider the relationship between the ABET(EAC/TAC)/NAIT standards or outcomes and student learning assessments. We wanted to see a much more direct link between the national standards, the student learning outcomes for each course, and the assessment tools for each course. Using the simple worksheet below, professors once again mapped student learning outcomes to tests and test items, to performance tasks and rubrics, and to each criterion. In completing this map, any gaps or missing links between what knowledge professors desired to measure and what they were actually including for measurement on the assessments became obvious. This is a critical analysis in developing any course, as it reveals important information about the quality of connections between what should be taught (as identified by the outcomes), and what learning is being measured (as identified by the test items or rubric criteria). The process leads to improved assessments or changes in outcomes (Linn & Baker, 1996 as cited in NSSE, 1996; Nitko, 2004) (To learn more about Performance Assessment, see Sections B9, C.3, and D4)

Table A.5.10: Tech 496 Industrial Project Management (See Sections B8 and C1)

Student Learning Objectives and Outcomes				Assessments: Test & Performance Task Alignments Midterm & Final	
	Student Learning Outcomes-Primary	**Student Learning Outcomes - Secondary**		**Corresponding Test and Tests Items**	**Corresponding Performance Tasks and Rubrics**
1		**a**			
		b			
		c			
2		**a**			
		b			
		c			

To learn about performance assessment, we engaged the professors in the development of performance tasks and corresponding rubrics. Thus, the learning and professional growth on the performance assessment knowledge component of the program was taught and measured by the professors' performance on the task of designing and developing three complex performance tasks and three corresponding rubrics for scoring task achievement. Using the rubrics below as guiding criteria, they each designed three complex performance tasks and corresponding rubrics. The performance assessments were added to their courses as a new assessment strategy and procedure.

It is important to note that one performance task/rubric was designed to correspond with the midterm and another with the final exam, using the logic that objective tests usually reflect what students know or know about rather than what they can do. Therefore, we used an unusual scenario where the professors "linked" the objective midterm exam to a midterm performance task/rubric and an objective final exam to a final performance task/rubric. They also developed a third performance task/rubric and choose how and when to use it during the course. They were asked to "match" where they thought the test items and performance tasks "overlapped" or measured the same or similar content. An assumption was made from studying the literature that performance assessment measures different aspects of learning, sometimes deeper levels of learning through use of knowledge in more active or engaging ways, problems, projects, etc. But performance assessment can also measure some of the same aspects of learning as objective tests. Also some of the professors designed their tests to incorporate some level of performance in subjective or problem-based items. In examining and analyzing the tests, the objective items were separated from the more performance-based items.

Professors were provided a presentation about performance assessment. Performance tasks and rubrics were discussed, and they received many examples of tasks and rubrics. They also received books on the topic as part of their new library on teaching and learning. Their performance tasks and rubrics reflect the ABET or NAIT outcomes. One professor had used rubrics before, "less formalized, somewhat more of a check off oriented form with less well developed descriptors or criteria and levels of achievement," but none of the professors had

developed or used formal, written, real-world, scenario-based performance tasks with corresponding and formal rubrics before this initiative. The one who had used a rubric, revised it after the program, making it more formal with clear and distinctive performance standards and criteria for each performance level. Thus, there were no previous instruments to review from the baseline semester, Fall 2005, to compare to these. Therefore, we judged them based upon the rubrics below (Linn & Baker, 1996 as cited in NSSE, 1996; see also Angelo & Cross, 1993 Chatterji, 2003; Nitko, 2004; Walvoord & Anderson, 1998; Wiggins, 1998).

<u>Faculty Development Program - Performance Task:</u> Design and develop three complex, real world and authentic <u>performance</u> <u>tasks</u> with corresponding <u>rubrics.</u> The professors based each of the performance tasks upon selected student learning outcomes, reflecting the ABET or NAIT outcomes and authentic real world tasks relevant to learning outcomes, and used rubrics for student assessment during the experimental research course, Fall 2006. See the rubrics below for the achievement standards and criteria.

<u>Professors' Performance:</u> The professors accomplished the performance task well. The process involved drafting initial and authentic real world scenarios with embedded task clusters and a corresponding rubric instrument for each task. The program leader provided feedback one-on-one. The professors shared their drafts with each other and benefited from the group critique process. The group process worked especially well. The tasks and rubrics were finalized; the program leader approved them; and then, each professor used the tasks and corresponding rubrics successfully with students during the 2006 experimental research semester. As with test analysis and development, the feedback from the professors on the value of learning to design, develop, and use performance tasks/rubrics was extremely positive.

The following rubrics were used to guide the professors in the development of the three performance tasks and corresponding rubrics for each task. (See Section B8)

Table A.5.11: Rubric for Assessing the Quality of a Performance Task

Key Components - Properly Designed Performance Tasks must

- **I. Be based on content standards established by ABET or NAIT**
- **II. Describe a "real-life" scenario; are real world, authentic tasks; require active performances**
- **III. Involve students in complex reasoning – critical thinking at upper levels of Bloom's Cognitive Dimension**
- **IV. Require students to collect and process information, using it for an authentic purpose**
- **V. Incorporate "habits of mind"**
- **VI. Require student collaboration and cooperation; incorporates "individual" and "group" learning and performance accountability**
- **VII. Result in a tangible product and/or communication activity**

For each component, there are descriptors reflecting levels of achievement possible:

I. The Performance Task is based on the ABET or NAIT standards

a. The Performance Task is directly related to the ABET or NAIT standards.
b. Learning standards are apparent, but the relation to the task and/or national standards is sketchy or not apparent.
c. The Performance Task does not appear to be based on the standards/outcomes, course or national.

II. The Performance Task describes a "real-life" scenario that is authentic and requires active performance.

a. The scenario described in the task accurately mirrors an activity in the community of practice outside the classroom.
b. The scenario described in the task simulates an activity in the community of practice outside the classroom.
c. The scenario described in the task contains some aspects of activity outside the classroom but is largely contrived.
d. The scenario described in the task is an academic exercise that usually takes place only in the context of an academic setting.

III. The Performance Task involves students in complex reasoning-critical thinking processes at upper levels of Bloom's Cognitive Dimension.

a. The task requires students to utilize complex reasoning – critical thinking skills, such as induction/deduction, diagnosis, abstracting, experimental inquiry, problem solving; evaluation, creation, synthesis, etc.
b. The task requires students to utilize complex reasoning components, such as comparing, classifying, decision making, or investigation.
c. The task requires students only to recall facts.

IV. The Performance Task requires students to collect and process information, using it for an authentic purpose.

a. The task incorporates a variety of information gathering techniques and information resources. Students are required to interpret and synthesize information and accurately assess the value of information gathered. They are required to collect the right information for an authentic purpose, e.g. solve a problem, apply or use in a complex project, etc.
b. The task requires students to gather and synthesize information, but the value of the information gathered is not assessed. Information may not be used for a purpose.
c. The task requires the students to gather information, but not to interpret it.
d. The task requires no gathering or processing of information.

V. The Performance Task incorporates "Habits of Mind."

a. The task requires students to make effective plans, use necessary resources, evaluate effectiveness of their own actions, seek accuracy, and engage in activities when answers or solutions are not immediately apparent.
b. The task only requires students to effectively plan or use resources.
c. The task does not require students to engage in self-regulation, critical, or creative thinking.

VI. The Performance Task requires student collaboration and cooperation; incorporates "individual" and "group" learning and performance accountability.

a. The task requires students to use interpersonal skills, work toward the achievement of team goals, and perform a variety of roles within the team. There is a formal team structure and process.
b. The task requires students to work together in teams but there are no measures described that ensure collaboration or cooperation among team members.
c. The task is completed largely by students on an individual basis rather than in student teams.

VII. The Performance Task results in a tangible product and/or communication activity.

a. The task result is a tangible product or communication activity comparable to that commonly produced in business or industry community of practice.
b. The task results in a product that is similar to those completed in business or industry community of practice, but lacks several components that make the product realistic.
c. The task does not result in a product or communication activity relevant to a business or industry community of practice.

(Scarborough, 2006 [Based upon White & Scarborough, 2004])

Table A.5.12: Rubric for Assessing the Quality of a Rubric

Properly Designed Rubrics Must

- **I. Contain a set of key components/standards to be assessed that reflect the student learning outcomes for the course, which are directly linked to the national outcomes.**
- **II. Include descriptors for each component/standard that are measurable.**
- **III. Have descriptors-criteria that are indicative of observable student performances or behaviors.**
- **IV. Incorporate a clear and well-defined scoring system**
- **V. (Optional) Include appropriate weights for each component and descriptor**

For each component, there are descriptors reflecting levels of achievement possible:

I. The rubric contains a set of key components (standards) to be assessed.

a. A complete list of key components-standards is provided for the performance task, including the embedded subtasks, if a cluster. The task(s) are directly connected to student learning outcomes for course and the national outcomes.
b. Key components/standards listed are not exhaustive for the performance task and/or subtasks embedded are not clear enough for student response or action; components or standards are not clearly connected to student learning outcomes for course.
c. Not all key components/standards describe student outcomes; some are not directly linked to national outcomes.
d. No key components are listed.

II. The rubric includes a set of descriptors-criteria for each key component or standard.

a. Descriptors-criteria for each component or standard are arranged in a clear hierarchy from non-achievement to full-achievement.
b. Descriptors-criteria are present for each component/standard, but obvious levels in some are missing.
c. Each component does not have an associated set of descriptors-criteria.

III. The rubric descriptors/criteria are clear and contain observable or measurable student performances or behaviors.

a. All descriptors-criteria clearly delineate levels of observable student performances or behaviors.
b. Most descriptors-criteria clearly delineate levels of observable student performances or behaviors.
c. Only a few descriptors-criteria clearly define levels of observable student performances or behaviors.
d. Descriptors-criteria do not describe observable student performances or behaviors.

IV. **Incorporate a clear and well-defined scoring system**

a. There is a well defined and clear system for scoring each component-standard and its descriptors-criteria. Points or percentages are assigned appropriate to instructional emphasis and performance values.
b. The scoring system lacks definition, clarity, and although there is a scoring system, some aspects are ambiguous, subjective or unclear.
c. There is no scoring system.

V. Optional: Appropriate weights are assigned to components and descriptors.

a. Component-standards and descriptors-criteria are each properly weighted according to instructional emphasis and performance values.
b. Weights are assigned, but point values do not reflect proper instructional emphasis or performance values in all cases.
c. Weights are assigned to some performance standards and descriptors, but not others.

(Scarborough, 2006 [Based upon White & Scarborough, 2004])

Midterm and Final Exam → Performance Assessment Correlation
Further Thought About Performance Assessment and its Relationship to Tests

Typically, traditional objective tests are only <u>indicators</u> of what students can do with the knowledge being measured. Performing well on a traditional test should not lead to a conclusion about what a student can do with that knowledge (e.g., how well they can use the knowledge). Traditional or objective tests usually measure what students know or know about, while performance assessments should engage students in authentic and real world performance tasks in which students actually do something with the knowledge learned. It is sometimes perceived by performance assessment advocates that performance assessments (if designed, developed and constructed well) are better evidence of what students are capable of doing with gained knowledge. That is assuming most traditional tests are written to measure memory for information, concepts, theories, facts. If, however, tests have been written to include items that are higher on Bloom's Taxonomy and require more critical thinking or problem solving, then those tests could provide evidence of learning beyond what students know about – what they can "do." If the problems are complex and well constructed, use of the knowledge will provide evidence of "doing" or using the knowledge in some way.

Some professors prefer to use tests intentionally as indicators of what students know about and then follow those tests with performance tasks requiring students to solve problems or engage in projects that require higher levels of critical thinking (the manipulation of facts, theories, concepts, information) in a context where particular constraints and conditions as well as tools, materials, procedures, etc. are set. If this is the goal, then a test and performance task(s) may be designed to measure some of the same knowledge while also measuring different knowledge, as they are distinctly different types of measures with the potential to accomplish different, as well as some of the same, measurement goals. Or performance tasks can be used to better understand the depth of a student's learning. Therefore, we asked the professors to design and develop objective midterm and final examinations as well as corresponding performance task(s) and scoring rubrics matching the content where possible or desirable. They were asked to identify the objective test items that they felt were being measured on the corresponding performance tasks, also providing the link to the specific rubric standards and criteria. This led to an understanding of what content was not measured across both types of assessments or remained measured using one tool or procedure. Clearly, the professors began to realize what they were measuring, what was not being measured, and also IF the measures truly focused on the knowledge being taught and outcomes to be achieved by the course.

A statistical correlation was run between the midterm exam and corresponding performance assessment and the final exam and corresponding performance examination for each professor's students. The results led the professors to consider the following:

1. Do they really feel that there is a segment of the objective tests and the performance tasks where there is a content match? If so, in our program, no external content validation was required. We assumed the professors knew their content (disciplinary bodies of knowledge). However, it is important to note that professors should validate the knowledge content for both the course and assessments, as well as the assessment procedures, etc. externally in the purest

sense of measurement or student assessment. That, however, takes more time to execute with a faculty learning community and, in our opinion, would be part of a Stage II faculty development program. Our focus was on test analysis, the development of objective tests with higher integrity, as well as improved and higher level test items, including problem solving items. In addition, our program focused on introducing them to the design, development, and use of performance tasks and rubrics as another type of learning measurement procedure or tool to broaden and better balance the overall student assessment plan for the course.

2. How are professors using the tests and performance task(s)? In our case, we encouraged them to design new tests with more items, a wider range of item types, items that offer the opportunity to perform at various levels of Bloom's learning (e.g., memory to synthesis, even creativity). We then asked them to design and develop corresponding performance tasks and rubrics to provide students the opportunity to provide evidence of learning through real world and authentic performances by incorporating formal performance assessments. So –
    a. Do professors feel that the objective tests are <u>indicators</u> of what students know and the performance tasks take the students to the <u>next</u> level where they are positioned to more deeply or critically use the knowledge measured on the objective tests?
    b. Do professors feel that they can better measure some types of knowledge with objective tests and other types of knowledge through performances?
    c. Other considerations
3. What might the correlation scores mean?[4] How can they be used?
    a. The correlation scores might have little or no meaning.
    b. The scores might provide insight about students.
    c. The scores might stimulate diagnostic thoughts about student assessment.
    d. The scores might show a statistical relationship between tests and performances if designed with that goal in mind.
    e. Other

Although we had hoped to use the correlations, we quickly realized that we were not at a point in student assessment program component to use the correlations meaningfully. Nor were the professors prepared to research such a complex topic about which they have just begun to become informed. Therefore, the study of the relationship between tests and performance assessment is now on the professors' future research agenda.

Multi-faceted and Balanced Assessment Plans
Regarding student assessment, we began where the professors were with a variety of tests and worked with them to perform a test analysis on the tests used in the 2005 course. Once they completed the analysis, they each developed two new tests: a midterm and final exam,

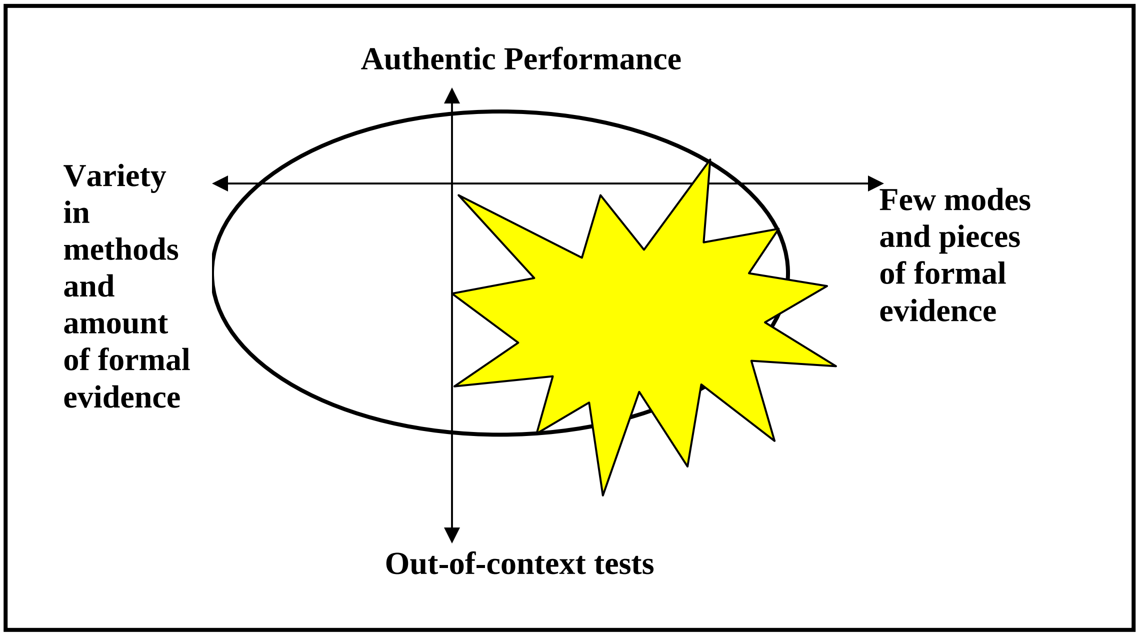
[4] Correlations have been computed in two ways: 1) leaving zero scores in as zeros and 2) replacing zero scores with blanks or taking them out (e.g., student was absent). Zeros have different meanings across professors. A zero can be the actual score for the student or could result from not taking the test. Rather than make individual determinations, both were computed.

for the re-developed course to be taught during the research semester, Fall 2006. Once that was accomplished, the professors were introduced to performance assessment and rubrics. We wanted them to broaden the types of performance assessments, but especially to add formal performance assessments. Therefore, we asked each of them to develop three complex performance tasks with corresponding rubrics to help them realize they could broaden their types of assessment while also realizing that this would broaden the opportunities for students to provide evidence of learning. Many of the professors had performances built into their 2005 tests, but the structure and criteria were often weak and the grading was far too subjective. Each professor completed the development of the performance tasks and rubrics, which turned out well for the professors and the students during the research semester.

The Ultimate Goal-Balanced and Multifaceted Assessment Plans

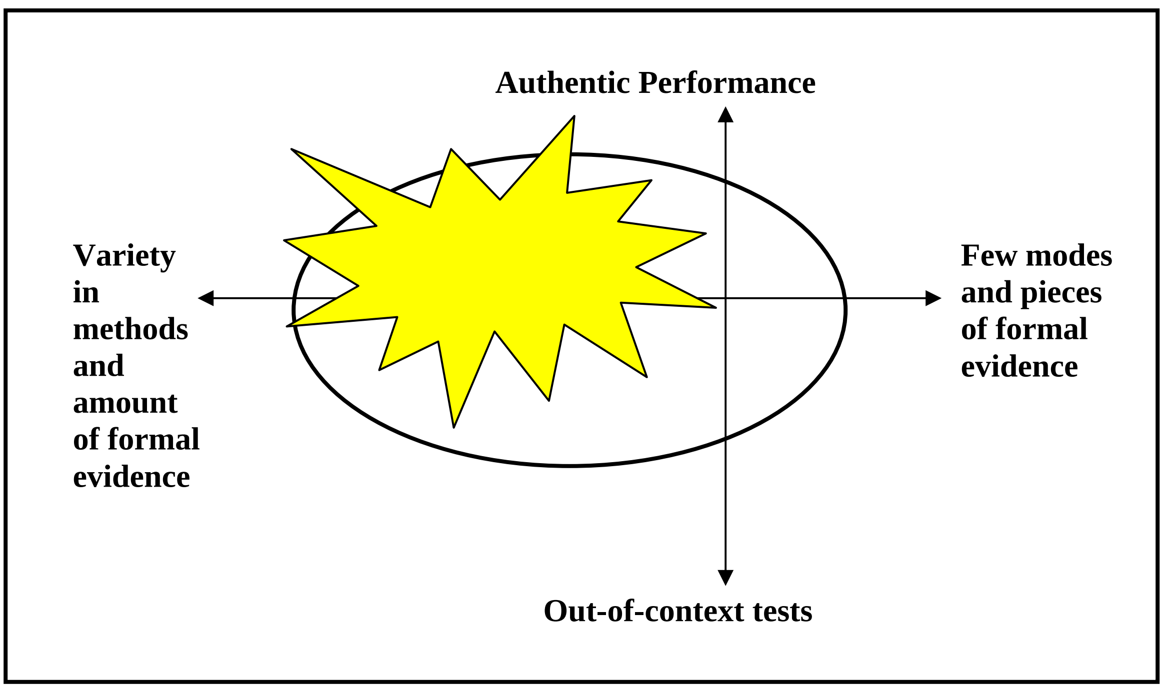
Finally, the ultimate goal was to have the professors realize there were still many more types of student assessments to be considered, and that the more opportunities for assessment and the more varied the types of assessments for student assessment, the better the assessment plan would be, as it would become more "balanced." (A balanced student assessment plan provides more reliable evidence of learning, making the determination of end-of-course grades less difficult and more accurately reflective of what a student knows and can do.) An old adage was mentioned: final exams should not "make or break" the grade, but finals (and midterms to that point in the course) really should confirm a final grade in the course. Multiple assessments of different varieties can reveal more clearly and deeply what students have really learned rather than what they have memorized for the short term. Therefore, we introduced the following graphic organizers as visuals for the professors to consider. With the visuals as an aid, they began to understand that assessments should be often, varied, and come in all forms of activities and that homework, papers, reports, projects, case studies, and so much more also provide evidence of learning and, therefore, can be considered assessments (Kuhs et al., 2001; Wiggins, 1998). Figures 8B1 and 8B2 reflect the difference between an unbalanced assessment plan and the exemplary assessment plan.

Figure A.5.8: Typical Imbalanced Assessment



(Wiggins, 1998, p. 115)

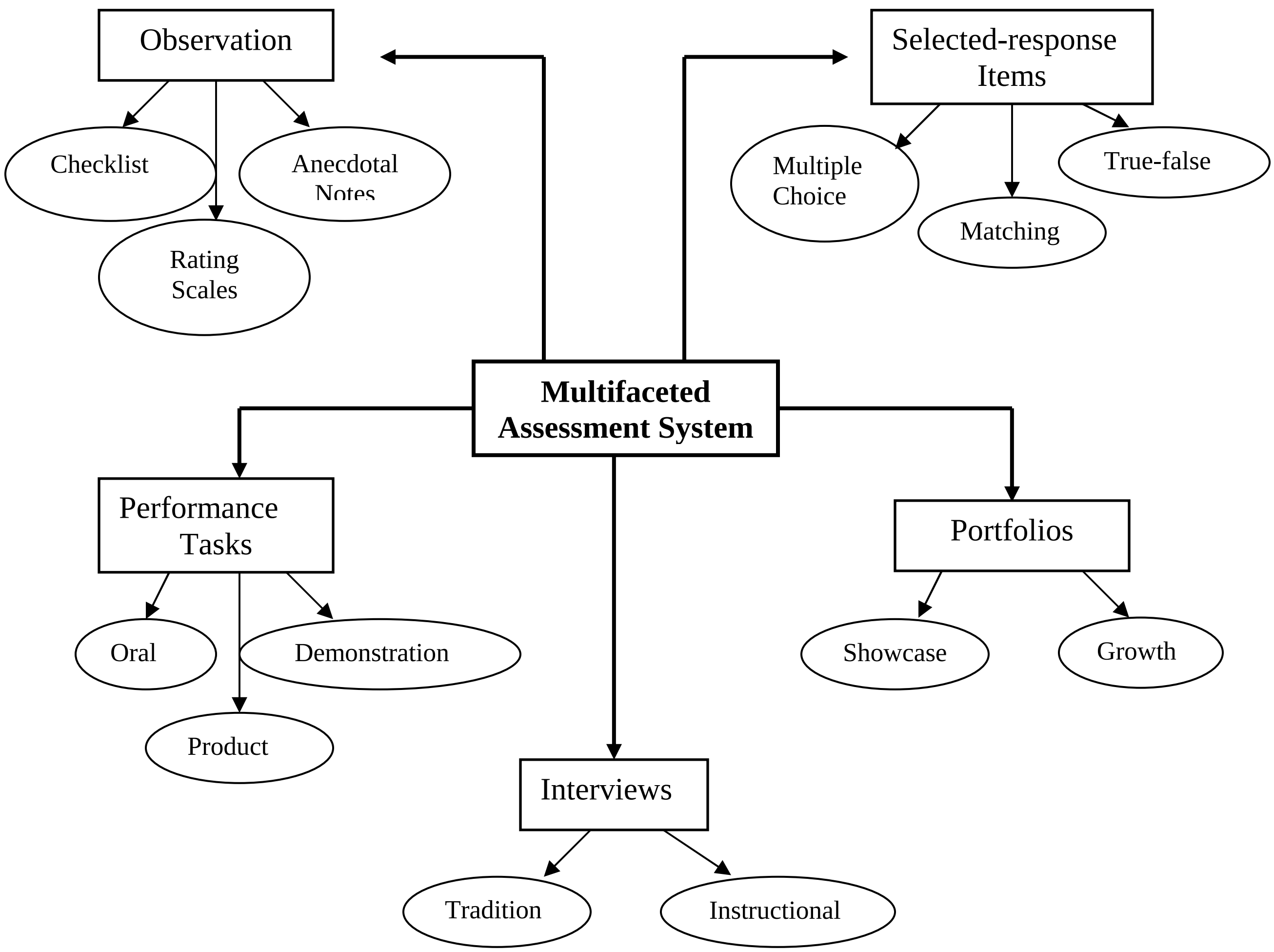
Figure A.5.9: Exemplary Assessment Balance



(Wiggins, 1998, p. 116; Scarborough adjustment)

Using the basic Kuhs et al. (2001) model immediately below, each professor mapped his/her assessment plan, producing a visual chart, like the Kuhs-Scarborough one (also below). The chart served as a tool to assist them in considering where they could expand to include additional types of assessments.

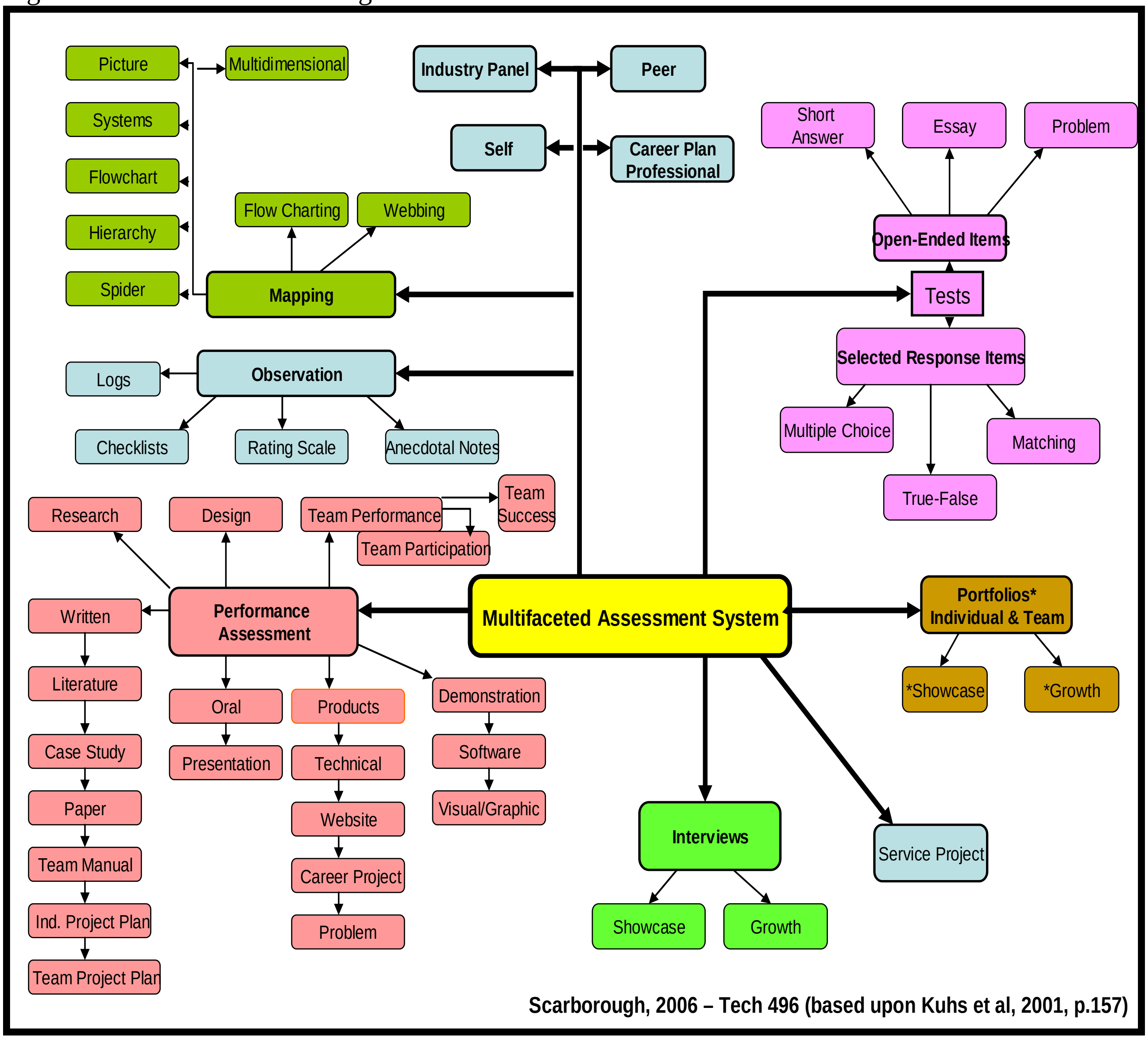
Figure A.5.10: Kuhs et al. Model



(Kuhs et al., 2001, p. 157)

Mapping the assessments assisted the professors to more clearly realize if the assessments were balanced regarding variety and to determine if there were enough assessment opportunities.

Figure A.5.11: Kuhs-Scarborough Model



Basic Model: (Kuhs et al., 2001, p. 157; Scarborough, 2005 – Technology 496-CEET)

After mapping the assessments using the Kuhs model, above, the professors completed the following chart using percentages to reveal the assessment content by Bloom's Cognitive Dimension levels for both tests and performance tasks. Some professors provided information on other types of assessments as well. This helped them to determine whether the assessments were designed to engage students at the higher level of cognitive processing and critical thinking. Also both the map above and the chart below reveal the entire assessment picture for each course. Each professor can clearly see if he/she has designed and developed assessments to achieve the assessment goals for their course.

Table A.5.13: Bloom's Taxonomy – Cognitive Dimension Analysis Chart for Assessments
(percentage of each assessment at each Cognitive Dimension)

Assessment Type	Knowledge	Comprehension	Application	Analyze	Synthesis	Evaluate
	Remember	Understand	Apply	Analyze	Evaluate	Create
Midterm Exam						
Final Exam						
Performance Task 1						
Performance Task 2						
Performance Task 3						
Other Assessments						

The Student Assessment Component of the Program went into much more depth about assessment. Generally, the program content for that component followed the book chapter (Scarborough, 2004) that summarizes the aspects of assessment important to this project as well as identifies the critical sources for its content. (See Section A7)

The following topics and related information were presented and then discussed with the professors to broaden their perspectives and deepen their understanding about assessment practices:

- Aligning Achievement Targets (ABET/TAC/NAIT outcomes) with Assessment Methods
- Assessment Quality
- Balanced Assessment
- Performance Assessment, Authentic Assessment, and Quality Rubrics
- Difference Between Tests and Authentic Tasks
- Learning Styles and Assessment
- Assessment <u>of</u>, <u>for</u>, and <u>as</u> Learning

Grading

"Faculty were astounded by students' lack of knowledge" (Mitchell, 1998, p. 128). More important was the widening gap in the ways in which student learn and the ways faculty teach! However, A's everywhere were more abundant than ever at the time of his article. This could suggest grade inflation. Mitchell's dean suggested that the group of faculty get together and consider expectations (for grades) as a group. There were, of course, defenders of grade inflation: students are stronger academically now, lower grades will hurt their job opportunities, and so many more. One of the more historical impacts on grade inflation was when students began to evaluate courses and instructors in the 1960s. Instructors feared backlash and still do, in my opinion. Mitchell says, however, that there is no fixed correlation between grades and instructor evaluation. This bears out, at least in my own situation. Mitchell (1998) discusses inflation, what grades mean, their value, and that "grades should be more than the "happenstance collection of idiosyncratic evaluations" (p. 128). Mitchell (1998) establishes that grades should really reflect genuine discriminations among individual student efforts; all other considerations are secondary. He suggests that a rational exchange across faculty members and instructors will fix the problem and provides faculty members with their historical grading averages. And even though there are classes that may actually

have all or a large group of superlative students, more often grading follows a predictable pattern. He notes that old habits die hard and that we must think seriously about grading and improve the inflation of grades. Although this may not be perceived as directly related to student demographics, to me it is directly, or at least indirectly, related. Students come to me as seniors, and if they have received A's to date with widely varying course requirements, especially less rigorous ones, little feedback, or little critical feedback about the level of their work, and if their courses have few required tests or products, then they have high grade expectations. Also if the grades they have received are not clear in meaning and/or if the grades they have received are inflated, then my job is very, very messy.

Mitchell (1998) notes, very important to our initiative, that despite the high academic rigor, students were still attaining good grades, even though coming to college less well prepared and with a growing need for remediation. Therefore, we included reading and discussion about what grades mean as a program component. We had serious discussions about "curving" grades and what it means. We ended by committing to, at least for the classroom experiment, set grading standards with an understanding that a professor not make test instead they ensure course and requirement rigor and teach differently to move the students toward achievement at higher levels. We have only just begun but hopefully have already made a difference with seven faculty members, some of whom have established and appropriate standards. The questions inherent in inflated grading are really about standards, expectations, and teaching. Once this becomes clear, faculty members feel more comfortable with higher expectations and established, yet transparent, standards of performance. This reduces their inclination to change them "on the fly" to make students appear more successful. We do have faculty members concerned about keeping students happy, and in all fairness to these same professors, they are concerned about not being able to really discriminate between several points that may make a grade level difference – rightfully so unless clear grading standards are in place.

This was a brief, but critical, program component. It focused on helping the professors understand how important the development of clear grading criteria is for student assessments, for the professor, and for collecting evidence of learning that has integrity for the student, course, and program. There was a great need with our group to dispel the myths about, and perceived benefits of, "curving" student assessment grades or course grades. It was fairly difficult to move some of the professors away from "curving" or widely subjective grading acts. However, there was great progress, and they agreed to stick with more prescribed, definitive, and transparent grading strategies for their assessments and somewhat for the course. This commitment was difficult because they wanted to assist students in being successful, but using their methods made the grade results for both assessments and the courses suspicious. However, the newly developed courses with all the direct connections and mapped outcomes to assessments, etc. led the professors to understand that when the connections are evident and students can clearly see what they are responsible for achieving, with <u>more</u> opportunities to provide evidence of learning and clear levels of potential performance, there really is no need for "easy" assessment items or the "curving" of grades. If the professors further explore <u>student self-assessment</u> (e.g., where students complete the rubrics before turning them into the professors for scoring or create portfolios to monitor their own learning and the more structured group/peer work), students will evolve even

further. Although briefer, but inherently a part of all the assessment sessions, this was a critical, necessary, and beneficial program component. All of the professors changed their assessments and grading strategies for the 2006 redeveloped course (About Grades, n.p.; Anderson & Speck, 1998; Dominowski, 2001; Frye, 1994; Royse, 2001).

Teaching Models

(See PowerPoint Presentation – D7 and Portfolio Section – B11)

By the time we focused on teaching models as a formal program component, professors had already become quite knowledgeable about the models below. The exposure resulting from initial analyses of their 2005 course, described above, served to more than familiarize them with the models. Although that analysis was driven somewhat less deeply, it provided them the chance to learn about teaching models and styles while comparing their current practices against a list and description of models and styles. The worksheet below engaged them in a more "studied" experience, where they learned more about each model and were asked to consider how to use each one in their redeveloped 2006 course. Initially, the strategy of having them refer to handouts with descriptions of each model and style worked to inform them well enough to make judgments about their 2005 practices, but the underlying cognitive theory was not revealed at that level of examining the models. Therefore, when we reached the stage of the program where they were to make instructional decisions about which teaching models and styles to incorporate, more depth was needed, especially regarding the cognitive psychology. It was important for them to realize that if they incorporated a wider repertoire of teaching models and styles, students could extend their primary learning style comfort zone to include learning equally well across a variety of learning styles. Also if a more diverse selection of models and styles was used, students could more actively achieve learning to higher cognitive levels. Although a presentation was prepared, because the professors were already so familiar with teaching models and styles, there was no need to use it at that point. Instead it was provided for them to review. They took the book by Joyce et al. (2004) and the following questionnaire home and were asked to engage in critical reflection about teaching models beyond the initial level by actually studying the models and the underlying cognitive learning psychology. In this activity, they were to identify each model, describe what it could mean for their teaching practice, and note how it could change their practice and the 2006 course. Rather than do this in class, we gave them the day at home. At that point in the program, we were into summer intersession, so a day at home was welcome. This exercise seemed to deepen their understanding of the models; thus, they broadened their repertoire of teaching models and made choices about which ones to incorporate into their redeveloped 2006 course instruction. Joyce et al (2004) presents the families of teaching models within the context of meta-cognition and uses inquiry and constructivism as the process for learning. Scaffolding is represented by the stairs to show gradual and progressive learning while constructing knowledge. The learning context also represents student learning communities in which students are engaged in zones of proximal development, an environment where they can stretch and grow without being overwhelmed or frustrated.

Figure A.5.13: The Learning Environment (See Portfolio Section B11)

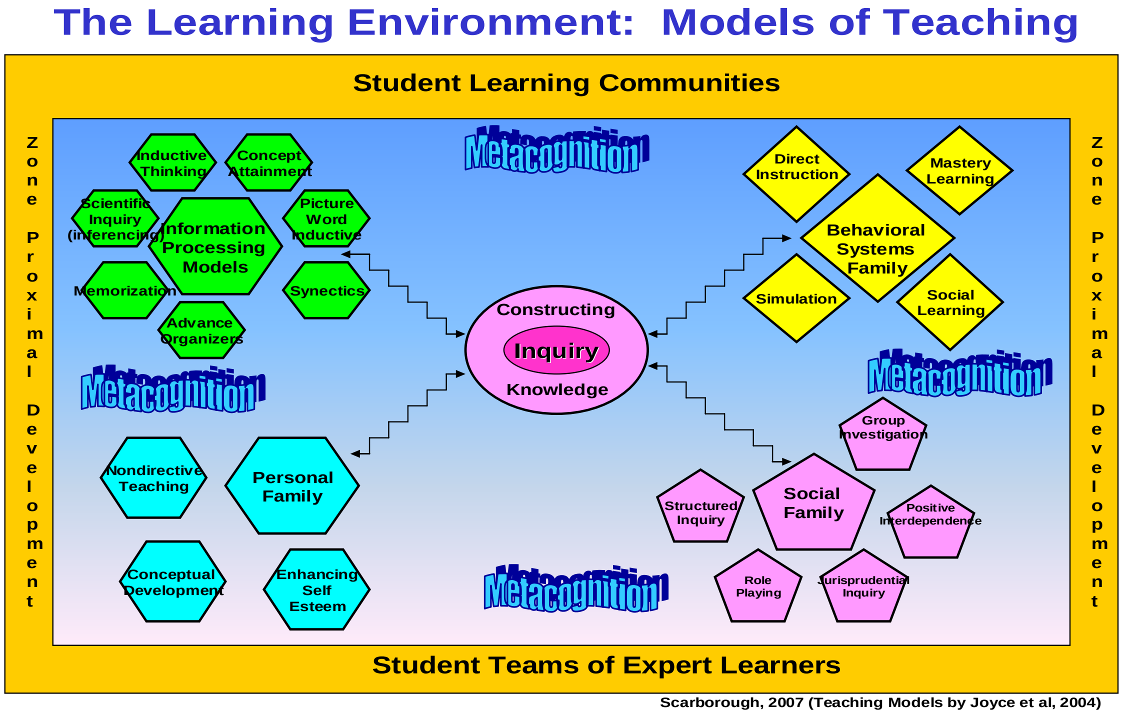
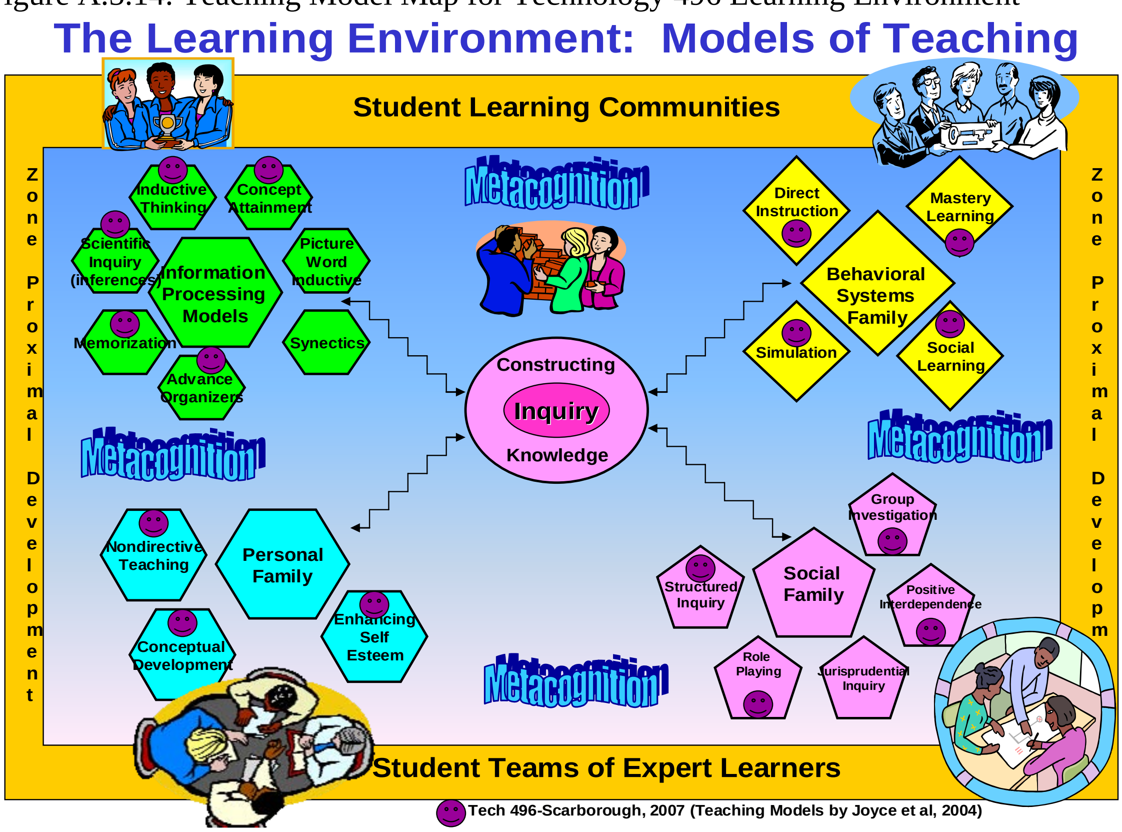


Figure A.5.14: Teaching Model Map for Technology 496 Learning Environment



The chart below served as the simple worksheet for the professors to further and more deeply study teaching models before making choices for their courses. After the professors completed their worksheet, they discussed their individual responses as a group, and where necessary, explanations to further inform or illustrate models were made by peers or the program leader. Each professor then made the instructional decisions on teaching models and styles for his/her course, keeping in mind how they wanted to stimulate students to use a variety of learning styles. It might be important to note that we encouraged the professors to select several to try in the 2006 course but not to overwhelm themselves with choosing too many new models to try all at once, further encouraging them to gradually try more models. However, we also explained that some of the models are natural to particular content or teaching situations and, therefore, not to miss "natural" opportunities to formalize the use of any model (Fry et al., 2003; Joyce et al., 2004; Kolb, 1984).

Table A.5.14: Foundation: Concepts that apply to Learning (See Portfolio – B10)

Concepts – Chapter 1, p.3	**Description**	**Meaning for Me and my Practice**	**Changes I will make based upon my understanding of this concept?**	**Where will these changes "show up" in the teaching and learning experiences throughout the semester?**
Constructivism, p. 12				
Metacognition, p. 14				
Scaffolding, p.14				
Zone of Proximal Development, p. 16				
Roles of Expert Performance, p. 20				

Table A.5.15: Models of Teaching

I. Models of Teaching – Information Processing Models (See Portfolio – B10)

Models	**Description**	**Strengths**	**Weaknesses**	**How I can use this model-describe**
Inductive thinking, Ch. 3, p. 41 (classification-oriented)				
Concept Attainment, Ch.4, p. 59 (includes concept formation)				
The Picture-Word Inductive Model Ch. 5, p. 77				
Scientific Inquiry, Ch. 6, p.101 Inquiry Training				
Mnemonics, Ch. 7, p. 131 (memory assists)				
Synectics, Ch. 8, p. 155 (includes metaphoric activity)				
Advance Organizers, Ch. 9, p. 187				

Table A.5.15: Models of Teaching (continued)

II. Models of Teaching – Social Models

Model	Description	Strengths	Weaknesses	How I can use this model-describe
Partners in Learning, Ch. 10, p. 205				
Positive Interdependence, p. 211				
Structured Inquiry, p. 221				
Group Investigation pp. 213-227				
Role Playing, Ch. 11, p. 229				
Jurisprudential Inquiry, Ch. 11, p. 249				

III. Models of Teaching – Personal Family

Model	Description	Strengths	Weaknesses	How I can use this model-describe
Nondirective teaching, Ch. 12, p. 271				
Enhancing Self-esteem, Ch. 13, p. 283				
Conceptual Development Ch. 13, p. 290				

IV. Models of Teaching – Behavioral Models

Model	Description	Strengths	Weaknesses	How I can use this model-describe
Mastery Learning, Ch. 14, p. 303 Programmed Schedule, p. 310 Programmed Schedule, p. 311 (task performance reinforcement)				
Direct Instruction, Ch. 15, p. 313				
Simulation, Ch. 16, p. 323 Training and Self-Training				
Social Learning, Ch. 14 (includes training & self-training)				

Although the professors clearly found they relied heavily on lectures in the 2005 courses, some of them did use other models but not to the degree of variety that was desired once they analyzed their courses. After they more deeply "studied" the models and made choices about the ones they wanted to incorporate into their delivery strategies for the course, they also developed the course schedule. When completed, the schedule was modified to provide columns where they could note the teaching models and styles they felt would work during the weeks and days of the course. This was, once again, an exercise that provided an opportunity to more critically consider when they could actually "plan" to use various models and styles, especially the ones they had not used before. It also provided the integrated activity to see the relationship between chosen teaching models and teaching styles. Furthermore, it illuminated the connection between teaching models and styles and student learning styles and how that could influence their potential achievement of Bloom's higher cognitive dimensions and Dale's more active learning levels. Although somewhat an "exercise," this activity brought about the connection between "planning and consideration of" and "actual use of" these models and styles to achieve higher student engagement and cognitive processing. It clearly required formal decisions, and the visual was a good method

to establish commitment to those decisions. Creating the course calendar led us into the syllabus program component, as a redesigned 2006 syllabus was a requirement for each professor. It might be important to note that some professors left the calendar showing the models, etc. rather than using that version for themselves and using the calendar without the information on the syllabus for the students. This made a somewhat messy syllabus and was not really recommended by the program directors. However, at that point in the program (the end), they were exhausted but pleased with their products and new instructional decisions. The legend for the form is below as well. This learning activity led to the proper component development of the 2006 syllabi.

Table A.5.16: Course Calendar: Topics, Class Schedule, Due Dates (2 day/week course)

Week & Outcomes	TM Dale	TS	LS	Day 1 Topics, Activities, Due Dates	TM Dale	TS	LS	Day 2 Topics, Activities, Due Dates
Week 1 Dates								
Week 2 Dates								

Table A.5.17: Course Calendar for Teaching/Learning Models and Styles Legend

Teaching & Learning Calendar Legend		
Teaching Models	**Teaching Styles**	**Kolb's Learning Styles**
(Joyce, Weil, Calhoun, 2004)	**(Mosston & Ashworth, 1990)**	**(Kolb, 1984)**
IT – inductive thinking	**C – command (A)**	**CE–concrete experience**
CA - concept attainment	**P – practice (B)**	**RO – reflective observation**
PWIM – picture word induction model	**R – reciprocal (C)**	**AC – abstract conceptualization**
ScI – scientific inquiry	**SC – self check (D)**	**AE – active experimentation**
M – mnemonics	**I – inclusion (E)**	
S – synectics	**GD – guided discovery (F)**	**Felder's Learning Styles**
AO – advance organizers	**CD – convergent discovery (G)**	**active vs. reflective;**
Partners	**DP – divergent production (H)**	**sensing vs. intuitive**
CL-I – cooperative learning-informal	**LD – learner designed (I)**	**visual vs. verbal**
CL-F – cooperative learning-formal	**LI – learner initiated)J)**	**sequential vs. global**
SI – structured inquiry	**ST – self teach (K)**	
GI – group investigation		**Bloom (1956)**
RP – role playing	**Teaching Styles**	**K-R – knowledge or remember**
JI – jurisprudential inquiry	**(Grasha, 1996)**	**C-U – comprehension-understanding**
NT-nondirective teaching	**E – expert**	**Ap - application or apply**
ES – enhancing self-esteem	**FA – formal authority**	**An - analyze**
ML – mastery learning	**PM – personal model**	**S-E- synthesize or evaluate**
PS – programmed schedule	**F - facilitator**	**E-C - evaluate or create**
DI – direct instruction	**D – delegator**	**Dale's Cone of Learning (1969)**
S - simulation		**P=listening; I-participation; A=doing**

Syllabus

Professors were asked to analyze their syllabi. As the most critical communication instrument, we addressed redevelopment of the syllabus equally beside all the teaching, learning, and assessment program components. Since the syllabus is supposed to inform students about the course, professor expectations, and their responsibilities, it clearly needs to communicate effectively. Such a syllabus should provide enough information so if students have choices about which semester is best for them to enroll in a particular course, they can make better choices because the information is available. CEET requires our course syllabi to be on file and available to students, and although good courses are usually modified, at least somewhat, each time they are offered, based upon student feedback or new content, etc., the recent past syllabus can inform a student well enough for more informed decision making.

There are many different styles of presenting information on a syllabus and just as many different preferences across professors about what to include on a syllabus. The philosophy used for the program was that students are entitled to full disclosure about the course and that the course should be planned in great detail where few changes, if any, are to take place. Only something unusual should result in a change, and changes would usually be to the students' benefit, so there should be no surprises or major changes in the course, its work, assignments, due dates, etc. This means, very simply, that professors must plan the course in its entirety. Although we had an excellent example, the program leader reviewed the literature to see if there were any suggestions that might further enhance the one we were using as a model. However, the literature review confirmed that ours was an excellent example, so we provided some of those articles to the professors for validation purposes. Using that exemplar and those articles, we operated with a bias that students should expect to receive full course disclosure on the course through a syllabus that reveals the following: (Campbell & Smith, 1997; Dominowski, 2002; Forsyth, 2004; Killian, 1995; Royse, 2001; Scarborough, 2006 - Tech 496).

- <u>Professor/Graduate Assistant Contact Information</u>: All information needed for appropriate student-professor contact, clearly making it possible for the students to be able to predictably get in touch with the professor and graduate assistant outside of class.
- <u>Catalog Course Description</u>: The course description taken from the college, department website, or catalog. The description should make clear all pre-requisites and focus or overall course objectives. If the course objective(s) or outcomes are not clearly inherent, it might be important to actually state the course objectives separately to link to the student learning outcomes mentioned below.
- <u>Course Purpose</u>: Although some feel that this is unnecessary, when used appropriately, it explains to students why the course is required or important, what it will do for them, and its context. When the purpose is described appropriately, students understand what knowledge and skills they will learn from the course, what the knowledge or skills will do to contribute to their overall plan and program, and finally – possibly most importantly, it creates the context for learning what the course offers, thus leading the professors to its importance in gaining employment professionally.

- Requirements: This makes very clear what students need or can expect that may or may not be normally assumed by students (e.g., text, calculator, computer, transportation, special labs, mention of special projects, etc.). For example, in Tech 496, a lab course that meets six hours each week, students are also required to meet in teams an additional number of hours each week. Although it is best to publish this type of requirement along with times and days on the web for registration, it clearly needs to be addressed the first day of class and published in the syllabus as the requirement affects student schedules overall.
- Expected Computer or Technology Skills: Knowledge or experience with particular software, mechanical skills, design skills, computer skills, etc. For example, most of our students are assumed to know how to search and use the Internet as a research tool; however, we have often found that students have good skills in particular uses or searches, but that we cannot assume those skills cross over a wider variety of searches and uses. They assume that Google, etc. will provide them access to everything they need, when in fact, particular search engines or indexes lead to different, "best," resources, etc.
- Pre-requisites: Other courses required before taking this one or information such as "senior status."
- Course Requirements (assessments, assignments, etc.) and Grading Information: This is a list of each assignment, assessment, and activity that contributes to the course grade. Grading is presented so students understand the percentages or points per assignment and the weight each holds as part of the total final course grade.
- Student Learning Outcomes: Clear listing of ABET/TAC/NAIT standards or outcomes and their connections to NIU's General Education Goals as well as the connections to student assessments. This presents clearly in outcome-oriented statements what they are going to learn or be able to do and how they will be assessed for evidence of learning, while clearly revealing the "assumed" knowledge and skills resulting from the embedded General Education knowledge and skills.
- Course Schedule: A very clear presentation of each course's weeks and days, revealing the topics to be covered, student activities, any speakers, DVDs, fieldtrips, and all assignments and/or assessments and their due dates. Identify special labs or meetings, holidays, etc. This should reflect the entire schedule and reveal what is going to occur or be due on each class day – the Plan and the Contract between student and professor.
- Course Requirements Explanation: This describes each item listed in the Course Requirements above and specifies what is expected of the student. It identifies and describes any particular strategies, processes, sources, formats, required software; whether it is a team or individual process or product; and, refers to rubrics, handouts, etc. Each description should make the assignment, activity, requirements, or assessments clear to the student and should be broken out into relational categories so that students can see how one type of learning activity relates to another. It helps to use a descriptor beside each category title. Visually, it helps if these are boxed. (See example below.) Finally, team versus individual

course requirements should be identified separately and, when possible, reveal how one leads to the other, if appropriate.

- NIU Academic Misconduct Policy: NIU's policies on academic misconduct and the process the professor will implement in class regarding any academic misconduct.
- Professor's Notes: Any specifics about course requirements, behavior, tardy/absence policies or policies regarding dress, cell phones, use of other technology, behavior, eating/drinking, and others specific to each professor.
- Student Support Services: Where students can seek academic support (e.g., NIU's accessibility services, tutoring, Writing Center, etc.), whether provided by specific NIU offices, the department, or the college.
- Course References (library reserve): A listing, location, and availability specifics of any resources being held on reserve for students in a particular course or on the Website and how to access the Website.
- Course Requirements/Points Check Off/ and Notes: It is important for students to monitor their own learning progress. To help that along, include a Check Off Form that lists each assignment, activity, or assessment, its point or percentage value, and due dates if preferred – separating individual versus team items. Require students to monitor themselves and check their progress by filling in the grades or scores they have acquired as each item is completed, then their progress to their goal grade. This type of form is used for that portfolio assessment as well.
- Grading Parameters: Grading values are clearly specified (e.g., how many points or what percentage results in an A, B,…); however, I have also included an atypical parameter. Using the term "Benchmark" to mean a student or product, behavior, or process that is identified as one others would want to achieve, an example of the best, is represented in the grading as 99-100%, a "benchmark for others." This seems to motivate students, whether younger or older, undergraduate or graduate, toward higher achievement. No longer are A's the goal in my classes. The students work harder to achieve the Benchmark status, although it is really no different than what has traditionally been available as a higher A status, but somehow, terming the highest level as "Benchmark" is very motivating.

Syllabus Model

Below is the example professors used for comparison. The syllabus is for the senior design capstone course in technology. The course integrates senior design with project management and leadership through formal teams. It is the culminating capstone course and results in formal individual student and team portfolios with complete evidence of learning for employers.

Figure A.5.12: Technology 496 - Industrial Project Management

Technology 496 - Industrial Project Management

Prof:_________ **Grad. Asst: _____** **Ph:** 753-0210 **Off.Hrs:** T12-3 **Email: _______**

I. Catalog Course Description: Industrial Project Management (3). Basic concepts, principles, and skills of project management. Designed to cover a variety of types of project management. Emphasis on computer tools and project management techniques. Analysis of case studies. Culminating project required.

II. Course Purpose & Objectives: To prepare project leaders and team members to formally initiate, execute and terminate industrial projects effectively. To integrate and apply knowledge, skills, and abilities acquired or extended during students' college careers (general education and major) and work experience to research, design, build and finalize a technical project within a team and formal project environment.

III. Required Text: <u>Project Management</u>. Cleland & Ireland, 2006 or latest edition.
Required: Date book/Calendar for scheduling and notes; Handout packet.

IV. Pre-requisites: Tech 265-Mfg. Processes; Tech 302- Graphic Pres.& Comm.;Tech 395-Ind. Data Processing; **Senior Status**

Expected Computer Usage: CAD, MS Office, MS Project, CNC, industrial equipment, or other, depending upon semester/ team project. **Required Laboratory Team Project:** Changes each semester; each team will engage in a complex technical project with specific technical standards to achieve, e.g., Go-kart, 3-car passenger train, hovercraft, paddle wheel boat, personal transport vehicle etc. Research, design, assembly of electrical/mechanical systems, testing, modifications/finalization with formal documentation, formal team products and team requirements. See requirements section, handouts, and rubrics.

V. Course Requirements

Individual Course Requirements:	Points:	Team Course Requirements:	Points:	Grading:
Text Project (broken into sections/due dates)	7	Team Operations Manual	5	Benchmark
Project Research	5	Community Leadership Service Project & Articles	3	A=98-100
Project Design	5			
Literature/Internet Research Tables A & B (Projs/Tms/Lead/Int'l/MCTms/MCLd)	7	Team Project Plan	5	A=93-97
		Team Project & Assessment (Final Exam)	7	B=92-85
Career Project	5			C= 84-77
Individual Case Study	5	*Peer Assessment Process & Team Success Assessment	5	D=76-70
Paper	7			F=69-below
Midterm: Individual Project Plan	7	*Team Member Participation (Ind. Pts. 3/5)		
Software Workshop/Test	5			
*Team Participation Awarded by Team	3	Team Presentation & Success (Final Exam)	5	
Project Feedback Logs	1			
Individual Portfolio & Assessment Process (Final Exam)	3	Team Project Portfolio & Website	5	
Professor's Overall Assessment		Final Exam II: TBD (if needed to confirm competencies)		
Ind. Presentation within Team Presentation.	5			
Total Individual Points Possible	**65**	**Total Team Points Possible**	**35**	
Professor's Privilege	See Note #2			

VI. Student Learning Outcomes

Student Learning Outcomes	Embedded NIU General Ed Goals	Embedded NAIT/ABET Learning Standards	Assessments/Rubrics
1A/B. Identify and describe major problems, issues, concerns, and solutions (PICS) that relate to (a) projects, (b) project management, (c) project teams, and (d) project leaders, also for (e) Int'l projects and (f) multicultural (MC) teams. **2. Identify and describe best practices for managing projects and leading teams; include Int'l teams and MC teams.**	**a.i.** communicate clearly in English, demonstrating ability to comprehend, analyze and interrogate critically; **ii.** communicate in a manner that unites theory, criticism, practice in speaking & listening; **a.iv.** Aware of and able to use various resources, including modern technology	**g.** demonstrate an ability to communicate effectively in writing**;** **h.** demonstrate an ability to communicate effectively orally; **m.** demonstrate an ability to ….utilize computer applications effectively**;** **k.** demonstrates a respect for diversity and knowledge of contemporary professional, societal and global issues.	Text Project or Text Test Research- Literature/Internet; Case study; Group analysis process Formal paper; group analysis 1-5 minute learning papers; Individual portfolios; Team Project portfolio/website; Individual/team presentations Team participation & Peer Assessment Team Operating Manual Individual and Team Project Plan Community leadership project
3a. Demonstrate effective project management of a technical project using appropriate PM techniques, tools, and processes: **a. planning,** **b. initiation,** **c. execution,** **d. termination** **e. evaluation** **f. problem solving** **g. leadership** **h. financial management** **i. procurement management** **j. scheduling** **k. MACE process and procedures** **3b. Design, develop, and deliver:** **e. executive team presentation** **f. team portfolio** **g. team website** **4. To integrate mathematics, the sciences, English, management, technical, technological systems knowledge and skills to accomplish individual and team project objectives:** **(a) Design, (b) Build a vehicle to technical specification that will operate; (c) Solve technical problems encountered; (d) test and evaluate the vehicle for meeting technical specifications and standards**	**a.** cultivate habits of writing, speaking, quantitative reasoning for continued learning: **a.i.** communicate clearly in English, demonstrating ability to comprehend, analyze and interrogate critically; **ii.** communicate in a manner that unites theory, criticism, practice in speaking & listening; **a.iii**.perform basic computations, display facility with use of quantitative reasoning in forming concepts for analysis and in problem solving, and interpret mathematical models and statistical info **a.iv.** Aware of and able to use various resources, including modern technology **b.** develop an ability to use modes of inquiry across a variety of disciplines in the physical sciences, mathematics: **b.iii.** demonstrate ability to use scientific methods, theories to science phenomena; **c.** develops understanding of discipline interrelatedness, applying that knowledge to an understanding of important problems & issues. **d.** develops social responsibility & preparation for citizenship through service and an appreciation of cultural diversity	**a.** demonstrate appropriate mastery of knowledge, techniques, skills, and modern tools of the discipline**;** **b.** demonstrate ability to apply current knowledge and adept to emerging applications of math, science, engineering and technology**;** **d.** demonstrate ability to apply creativity in the design of systems, components or processes appropriate to program objectives; **f.** demonstrate ability to identify, analyze, and solve technical problems; **g-h.** demonstrate ability to communicate effectively in writing and orally**;** **l.** demonstrate commitment to quality, timeliness, and continuous improvement; **m.** demonstrate ability to ….utilize computer applications effectively; **o.** demonstrate an ability to manage projects, industrial systems, lead personnel effect. **p.** demonstrate an ability to manage and manipulate industrial systems; **q.** demonstrate knowledge, strategies and/or techniques of how to lead personnel and teams effectively **e.** demonstrate ability to function effectively on teams**;** **j.** demonstrate ability to understand profess-ional, ethical, social responsibilities**;** **k.** demonstrate respect for diversity, knowledge of contemporary professional, societal and global issues	Individual & Team project research Individual & Team project design Written individual & team plan(s); Technical project prototype product produced to technical standards and specifications using technical processes Project testing & evaluation against established standards and specifications using formal evaluation tools and procedures MS Project 2003 test and application in project planning, execution, termination, assessment and evaluation MACE-Project assessment (Plan compliance & adjustments) Individual & Team Logs Individual and Team Portfolio(s); website(s); Individual and team presentations; Industrial panel evaluation Project termination with lessons learned Project evaluation by industrial panel Team Operations Manual; Team Plan Team presentation; portfolios; website; Team peer,, team, & conflict assessments/logs; Industrial panel evaluation; Formal paper ;5 minute learning papers Team success rubric

VII. Topics, Class Schedule & Due Dates

Wk/Dte	Topics	Date	Topics/Lab Act.	Assignment Due Dates
1 Course Intro	9:30 Writing Center Requirements (Jacky) 9: 45Career Project Intro and Requirements (Norwood) 10:00 Team Selection/Scheduling 10:30 Course Intro 11:30 Legacy Group Use of Planner & The Nature of Multitasking Project Research Assignment	**Teaming Team Assess.**	Team Skills Bank Finalize Teams & Schedules Plan Team Service Project Project Research Review **Schedule Writing Center NOW!!!!**	**Due 1/20** **Writing Center Appointments** **Project Research** **Bring Planner** **Community Service Art. & Plan Due1/20 4:00pm**
2 Text 1-4, 19	TEXT Highlights	**Teaming** ***210 sched.**	Project Design Lab	**Writing Center Appts. Due 1/25** **Text Proj. 1-4, 19, 20 due 1/25** **Industry Case ID due 1/25** **Final Project Research due 1/27**
3 Teaming Text 18 & HB	Project Teams: hidden agendas, teamwork, effective teams & members, member roles & responsibilities – Peer Assessment **(Team Packet Required)**	**Research Design *210 sched.**	Project Design Lab	**Text Project 18, 21 due 2/1** **Project Design due 2/4 Friday**
4 Teaming Text 20	Project Teams: conflict resolution, decision-making, teams in trouble, empowerment, trust, recognition **(Team Packet Required)**	**Teaming**	Team Manual Lab	**Lit. Research Table due 2/8** **Career Project due 2/11**
5 **Project Plan Text 11,6**	Project Planning - Section I Rubric & TEXT Vision, Mission, Intro, Purpose, Scope, Objectives, Deliverables, Charter, Org. Charts, Stakeholder Analysis, Com Interface, Project Review, Change Plan **[Paper due]**	**Teaming**	Research, Case, Paper, Career Validation Activity – Group Process Team Manual Lab	**Industry Case due 2/15** **Text Proj. 6, 8, 11, 16 due 2/15** **Team Manual due 2/14**
6 **Project Plan Text 13,**	Project Planning - Section II Rubric & TEXT Business & Proj. Success Factors, SWOT Analysis, Project Constraints, Risk Analysis, Contingency Plans & Trade Offs, Statement of Work, Goals, Work Break-down Structure	**Project Planning** ***210 sched.**	Project Planning – Section II Lab	**Community Leadership Project and Articles due 2/25 Friday** **Paper due 2/21**
7 **Project Plan**	Section II Rubric & TEXT (Continued) Life Cycle, Productivity Plan, Quality Standards & Metrics, Project Monitoring, Assessment, Control and Evaluation, Linear Charts, Resource Plan/Budget MS Project - PM Software	**Software Workshop** ***210 sched.**	MS Project-PM Software	**Text Proj. 5,9, 12, 13, 14, 15 due 3/1**
8 Project Plan	Section III Rubric & TEXT Environmental/Safety Plan, Security Plan, Documentation/Configuration Mgmt. Plan, Project Divestment & Termination Plan	**Software Workshop *210 sched.**	MS Project-PM software	**Individual Plans due 3/11** **Software Test due by 3/9**
	BREAK	**3/17**	**BREAK**	
9	Project Development & Teamwork	**3/24**	Project Development & Teamwork **[Logs]**	**Individual Portfolios due 3/22** **Team Plans due 3/25**
10	Project Development & Teamwork	**3/31**	Project Development & Teamwork **[Logs]**	**Individual Portfolios due**
11	Project Development & Teamwork	**4/7**	Project Development & Teamwork**[Logs]**	
12	Project Development & Teamwork	**4/14**	Project Development & Teamwork**[Logs]**	
13	Project Development & Teamwork	**4/21**	Project Development & Teamwork **[Logs]**	
14	Project Development & Teamwork	**4/28**	Project Testing and Initial Assessment	**Proj. Test./Assess due 4/28**
15	**[Final Project Assessment & Grade]** [Peer Assessments Executed & Due] [Team Member Participation Determined]	**5/5**	**[Team Presentations 8:30am-12:30]** **[Team Portfolio/Website/Success due]**	**Team ProjectAssessment due 5/3** **Team Pres./Port./Web. 5/5**
16 May_____ **Finals Week**		**5/12**	**Final Exam: TBD** **If needed to confirm competencies**	

VIII. Course Requirements Explanation – Individual Requirements:

Text Project: Read the entire text and answer the take-home questions. You will engage in a group process and then participate in a non-traditional test on this content to ensure concept attainment. ***Individual and Group Process.***

Technical Research and Design

Project Research: Research project assigned. More information about this research will be provided in class. However, it will entail an Internet/Literature search, possibly interviewing technical experts, local or suburban vendors or manufacturers, or other professors, and/or researching specific technicalities. It will also include research of all properties of materials, mathematics, and scientific principles, theories involved in the technical aspects of the project. Use research information to design the project. ***See Rubric. Individual and Group Process.***

Project Design: Students will design and prepare visuals and working drawings, schematics, etc. for the project using prior design and computer aided drafting or mechanical drawing knowledge and skills. ***See Rubric. Individual and group process.***

Real World Validation – Culminating Paper

Literature/Internet Research A: Search the literature (Internet) on project management, project teams, and project leadership; identify 45 quality sources, 15 each about **(a)**industrial projects**,(b)** project teams, and **(c)**project leadership. Develop a literature/source review **Table** summarizing what the literature/sources revealed. Topics of focus should be the**(1.)**problems, issues, concerns, **(PICs)** difficulties that arise on projects or for the teams and leaders and **(2.)**success strategies that have worked for projects, project teams or leaders in resolving the problems/issues. There must be 45 sources; these must be from major recognized journals or books on the topics. You may, however, include up to five non-traditional sources, e.g., Internet sources from industrial groups, project teams, etc. Sources must show depth in content; short "briefs" are not acceptable. **Copy** all sources if not books on **diskette** or **CD** rather than hardcopies. ***See Table Format and Rubric. Group Process-Be prepared to discuss; thus, if no hardcopies available for reference, you need to know the material well.*** ****Create tables that are categorized, numbered and reveal in-depth information with solutions. May use for your paper.**

Literature A + B = Total Table (See Rubric)

Literature/Internet Research B: Also, research **(a)**international projects, **(b)**multicultural teams, and **(c)**international project leadership with a multicultural team; identify 15 (5 for each topic) Internet and/or literature sources that discuss **(1.)**problems, issues and **(2.)** best practices, benefits, successes of multicultural/international projects, teams, and project or team leadership. Summarize the information learned by organizing it into a T**able** identifying the source author, title, main points on problems, issues, and benefits and your comments. ***See Rubric. Individual/Group Process-Be prepared to discuss; thus, your if no hardcopies available for your reference, you need to know the material well.*** ****Create tables that are categorized, numbered and reveal in-depth information with solutions. May use for paper.**

Industrial Case Study: Identify a company that will allow you to visit and interview an industrial project team. Interview a **project leader or manager** and **at least three project team members** *or 2 project leaders and 2 project team members.* **(1.)**Ask them to identify all problems, issues, concerns, **(PICs)** or difficulties encountered on the project, about the project, team., and project leadership. Have them explain in detail; **(2.)**then, also ask them what strategies are successful for projects, teams, and project leaders. Create a table of questions and responses and present what was learned as "real-time" research. ***See Rubric and Format*. *Individual and Group Process*. Incorporate the results into your paper.**

Formal Paper: Meet with WC tutor to organize paper. Develop a paper about projects, teams and project leadership; develop the issues and solutions in greater depth; draw conclusions and describe effective project management, effective project teams, and effective project leadership. What strategies, techniques, processes should be used to have a more successful project, team, or leader/leadership process? End with very specific recommendations to guide your project team on each of the 3 primary topics. Then include a section on how international projects and multi-cultural teams differ, what additional concerns, problems, and issues occur when operating internationally with diverse cultures. Make recommendations for successful international projects and on how to be a more effective leader of multicultural teams. Sixty (60) sources required (45 + 15). These 60 sources **<u>may or may not</u>** be the same ones that you identified for the literature review table. ****Incorporate the results of industrial case study** into your paper as well. Use the **APA** writing style manual. Identify all sources **in the paper's text** and in References Cited using the APA style format. Writing skills are seriously graded on this product. ***See Writing Rubric, Paper Outline & Rubric*. *Individual and Group Process.***

Project Planning - Midterm Exam

MS Project Software Workshops/Test: Participate in the software workshop(s). Complete **Test.** MS Project documents required in PLANs.

Midterm - Individual Project Plan: Use the outline & rubric provided as a guide, develop a detailed project plan. The plan will not be accepted unless every category is complete. Reference the text, other sources in the library or through the Internet, or sources listed on the course syllabus. All members of a team must have their plan in and graded before they will be approved to work on the "team" plan. This is another product where writing will be graded seriously. This is technical writing which is different than the narrative or prose approach used in the above assignments. ***See Plan Outline/Rubric. I/GP***

Employment

Career Project: a) Interview Mr. Norwood, the CEET Career Planning & Placement specialist, on the assigned topic; engage in group process. Document findings as assigned (TBD); **b)**Research jobs/positions/career in project management; Bring in copies of 10 position announcements which review expectations, required knowledge, skills, background for those seeking to become project managers, team leaders, or project team members; **c)** Design and develop a resume to use to seek such a position, but also make it applicable for other industrial technology, management, engineering, etc. positions. Have it reviewed and approved by Mr. Norwood for inclusion into personal 496 portfolio. Mr. Norwood will grade this project.

Individual Portfolio: This portfolio has a somewhat different focus. Although it may contain everything in the team portfolio for job-seeking purposes, it must also include all individual work, including Writing Center Reviews and multiple iterations of particular products. Use Course Requirements list on Course Syllabus (above) and Team Portfolio Rubric to determine what is to be included. You will participate in assessment activities throughout the semester, including analysis and reflections about what your strengths and weaknesses are and what you **can do to improve or continue well. The portfolio must be professionally presented, e.g., typed tabs, etc. Final Reflections at end of semester/questions to answer..**

Team Requirements:

Community Service Project: Each team has to research, determine, plan and execute an 8 hour service project. Research one article per team member on the benefits of community service and leadership by local industrial personnel. Generate a brief team plan of what, who, when and where. It should include a goal, operational objectives, expected outcomes and benefit to group served. Prepare an **informal presentation** about what you learned, how you felt and your potential future in community service. ***See Rubric*.** ***Individual/ Group Process***

Team Process

Team Manual: The team manual includes all team operational policies and procedures, the team problem-solving process, communication strategy and procedures, decision-making process, authority linear charts, team roles and responsibilities, etc. The team is to provide evidence that it operated using the team manual as its structure, process and guiding document. ***See Outline/Rubric. Group Process.***

Included in the Team Manual are the following critical components, plus others: See Team Manual Outline/Rubric. **Group Process.**

> **Team Skills Bank**: Each team will prepare a team skills bank that identifies all individual talent, skills, knowledge that each team member brings to the project. This bank will be used to organize the team, project, work packages and deliverables. **Group Process.**
>
> **Team/Project Charter, Logo, Company & Project Organizational Chart:** Each team will create an official charter, identify a team logo, and design an organizational chart for their company and their team/project. **Group Process.**
>
> **Team Assessment Inventory(ies):** Each team will design and develop a peer and team status inventory to use to monitor team process; they will also adapt a conflict management inventory to use to monitor the team conflict resolution process. The information gained from using these inventories will be used to build and strengthen the team and to identify and solve team issues or problems. Growth and development should be an outcome of using these instruments. Each team must produce a report of results from using these instruments and assessment process twice during the project period.

Team Project Plan: Each team must write/develop a team plan; however, the team may not begin on the team plan until all individual plans are graded and returned. The plan outline is the same as the individual plan. Each team must produce a plan for the technical project assigned and use the plan as a compliance document to monitor, assess, control and evaluate the project. ***See Outline/Rubric*.** ***Group Proc.***

Logs: Periodically you will be asked to complete a log about how you feel the team and project are progressing. Completed and turn in.

Individual Component of Team Presentation: Speaking, non-verbal communication, presentation skills, content, grammar/wording visuals, style, organization, use of technology, humor, etc. graded individually during team presentation. Remember that each team member must demonstrate speaking and presentation skills. Teams could acquire the full point value, but individuals will be assessed on their individual performance as well. Professional dress required. ***See Presentation Outline/Rubric.***

Team Participation Points Awarded by Team: Each team member will be allocated points for team participation. Teams will award points to team members for quality of work/participation - to "grade" participation. Professor validates that the distribution is appropriate for participation observed. Full participation is expected of each team member. Tardiness/absences from team meetings, class, labs are not acceptable behaviors. You will be asked to explain why you are late/ absent; points will be deducted. ***See Rubric*.** ***Individual/ Group Process***

Final Exam

Team Project: Each team will be responsible for designing and developing a technical project. You will generate technical standards to achieve and the metrics to use to measure the standards achievement level. The project must "function" or "work" to be accepted for a grade. It must meet the standards at the level described in the team plan using the metrics predetermined. Every team member must have major project role and responsibilities. The team must complete the project by the deadline on the syllabus. The project is the "vehicle" providing evidence of high performance teaming and project management as well as the knowledge, skills, and abilities from academic career and work experience. ***Team derived/Professor approved- predetermined -Standards/metrics = grading Rubric. Group Process.***

Team Portfolio: The portfolio is the culminating documentation of all project and team work. It must include information on every topic listed in the outline/rubric. It should include pictures, mechanical drawings, etc. and be professionally produced in hard-copy form. An operator's and maintenance manual must be developed and included for the technical project (product). ***See Rubric. Group Process.***

Team Website: Each team is to design and produce a team web-site which will serve as an electronic portfolio. This website/ portfolio must be presented during the team presentation. The outline is the same as the hard-copy portfolio. A CD must be included in the hard copy of the team portfolio. ***See Rubric. Group Process.***

Final Team Presentation: Each team is to professionally present their project, portfolio/website and information for each category on the presentation outline. This is a formal presentation where communication skills, presentation skills, etc. will be graded. Professional dress required. An industrial panel will observe the presentations. ***Presentation CD must be in Portfolio. See Outline/Rubric.***

IX. Academic Misconduct: Refer to the NIU Judicial Code; Immediate and appropriate actions will occur for any students behaving inappropriately, e.g., cheating, will be dismissed from the course immediately.

X. Professor's Role: This course involves the professor and graduate assistant in a variety of roles; the professor will provide a scenario, objectives, and standards and then guide, coach, and direct most of the time, however, there will be some lectures. This course is performance based, thus, there are usually no traditional objective tests. There are subjective tests in the form of the 5-10 minute learning papers, essays and the text project to determine concept attainment. Students will construct knowledge/skills while engaged in learning & performances. Assessment will occur as learning occurs.

XI. Professor's Notes:

1. Unexcused absences could result in one letter grade reduction each **(7pts)**. Class/lab/ team meetings/work sessions attendance mandatory. **Tardiness unacceptable. Door may close when class begins; late admittance may not be permitted according to prof.'s perogative.** Unexcused class/team tardies, **1 point per 30 minutes IF you are allowed in and door is open; don't count on door being open.**
2. The professor reserves the right to determine the final grade in the case of a student who does not perform on the team.
3. Unexcused late projects/assignments will result in point reduction, **2 points per day late**.
4. Dress code: no hats in lab **ever**! Professional dress **required** for final presentation.
5. Monitor language in class/lab at all times; good grammar and communication skills expected at all times; professional language expected.
6. Students are required to see the Writing Center tutor for all written assignments until approved otherwise, at least 2 visits per assignment; 3 visits required for paper. **(1)** Meet once to design paper, then meet with draft in hand **(2-3)** twice and rewrite. An appointment to plan the written assignment with no draft for review would still require 2 other visits for all other assignments.
7. Unannounced individual portfolio checks throughout course; 5 point penalties for portfolios not up to date each time.
8. No cell phone ringers in the class or lab at any time; **5 points deducted for in-class interruptions**. See professor exception approval.
9. **Students cannot pass class without ALL assignments turned in. Student will receive an I (incomplete) until all assignments are turned in. Penalties may occur for grades of Incomplete.**

XII. Support Services Available for Students: The NIU writing center provides tutoring for writing. Students in this class are required to use that service for all written assignments; each writing assignment requires two visits/critiques and rewrites before assignment can be handed in to professor. Tutor signatures and forms are required to be turned in with written products. Math and science tutors available in College. NIU accommodations for any student with special needs. See professor individually.

XIII. References on reference in Founders Library on NIU main campus: Kerzner. Smith. Project Management & Teamwork. McGraw-Hill. Angus, Gundersen, Cultinane. Planning, Performing and Control- ling Projects. Prentice Hall. 2000; Dinsmore. Human Factors in Project Management. Dinsmore. Project Management. Thomsett. The Little Black Book of Project Management. AMACOM; Kerzner, Thamhain. Project Management Operating Guidelines. VNR.; Rosenau. Successful Project Management. VNR.; Weiss, Wysocki. 5-Phase Project Management. Addison Wesley; Cleland, Gareis. Global Project Management Handbook. McGraw-Hill.; Miller. Visual Project Planning & Scheduling; Barkley, Saylor. Customer Driven Project Management. McGraw-Hill; Lewis. Mastering Project Management. McGraw-Hill; Forseberg, Mooz, Goterman. Visualizing Project Management. Wiley; Dinsmore. Winning in Business With Enterprise Project Management. AMACOM; Graham, Englund. Creating an Environment for Successful Projects. JoseyBass;Gray, Larson. Project Management. McGraw Hill. 2000.; Cleland. Project Management. McGraw-Hill; Meredith, Mantel. Project Management. Wiley. 2000; Lewis. Team-based Project Management. AMACOM; Kliem, Ludin. Project Management Practitioner's Handbook. AMACOM; Kerzner. In Search of Excellence in Project Management. ITP VNR; Ruskin, Estes. What Every Engineer Should Know About Project Management. Dekker; Buttrick. The Project Workout. FT Pitman; Rowenau. Project Management for Engineers. Ran Nostrand Reinhold; Cleland. Field Guide to Project Management. ITP VNR; Briner, Geddings, Hastings. Project Leadership. Van Nostrand Reinhold; Rosenau. Successful Project Mgmt. Wi.

XIV. Course Requirements Check Off

Individual Contributions: **Benchmark=98-100 (This means that you set the standard for others.)**

A=93-100 points
B=92.9-85 points
C=84.9-77 points
D=76.9-70 points
F=Below 70 points

_____ (7) Text Project

_____ (5) Project Research

_____ (5) Project Design

_____ (7) Literature/Internet Research Tables A & B

_____ (5) Career Project

_____ (5) Industrial Case Study

_____ (7) Paper

_____ (7) Midterm: Individual Project Plan

_____ (5) Software Workshop/Test

_____ (1) Project Feedback Logs

_____ (5) Professor's Overall Assessment

_____ **(65) Total Individual Points Possible**

Note: To keep track of your progress, add the possible points of work to date; then figure the percentage, e.g.,
Text (7)+P.Research(5)+P.Design(5)=17
.93 x 17 = 15.81 = lowest possible score or point value to maintain an A(lowest A).

IF your goal is to be a **Benchmark Student,** where your work best exemplifies the (confirmed by Professor) course's highest standards …where you set the standard, then you must maintain no lower than 98% or ultimately 98 points for the course.

Team Contributions:

_____ (5) Team Manual

_____ (3) Community/Leadership Service Project/Articles

_____ (5) Team Project Plan

_____ (7) Team Project & Assessment (Final Exam)

_____ (5) *Peer Assessment Process/Team Success

_____ (5) *Team Member Participation

_____ (5) Team Presentation & Success (Final Exam)
*Individual Presentation (in Team Final Presentation)

_____ (5) Team Project Portfolio & Website

_____ **(35) Total Team Points Possible**

IF a team's goal is to be a **Benchmark** Team**,** where the team best exemplifies the course's highest standards for teams… where the team sets the standard for other teams, then **every team member** in that team must maintain **98**% or ultimately 98 points each for the course.

Faculty Development
Relevant Literature on Reflective Practice

To review, the NIU CEET initiative is all about change. To implement the Scholarship of Teaching through classroom research, there was a need to first create a faculty learning community and then provide faculty development for the "community." As described above, a needs assessment was performed; overall goals were identified; the program was designed, and then both a literature and program search were conducted to determine if there were any existing programs, in part or whole, that matched our needs. We found no programs and very few components that could be pulled together to create the program that we felt was necessary to prepare the faculty community for the Scholarship of Teaching. The underlying philosophy of our program was that of engaging faculty members in a fully integrated program. Teaching, learning, and student assessment along with several other topics are not easily separated, as they are truly interdependent. We wanted a "program," not a series of workshops; we wanted to follow our faculty members into their classrooms where they would begin their experimental research. That was also an important aspect of the "program" approach – to include the classroom research as a component of the faculty development program. Once the needs were clearly identified, the literature was reviewed and documented, and finally, the university Professional and Organization Development Network (POD), a network of faculty development professionals and units across universities nationally, was tapped to see if any other university had programs important to know about or draw from. We then developed our program and engaged in the development of faculty on the Scholarship of Teaching. See Section A.3 for the CEET Vision, Mission, Goals, etc.

Our underlying premise was that change cannot occur without serious reflection about current practices, the critical analysis of the effectiveness of those practices, diagnosis regarding the less effective practices, identification of potentially beneficial changes, decisions about engaging in new practices, research on practices to evaluate their effectiveness on student learning, using the research results, other feedback and evaluation information to close the change loop, and finally, to fully implement new practices. Thus, we engaged in formal critical reflection to determine the GAP between "current practices," quality, and our "vision," which began the Reflective Practice journey for our learning community of faculty. We are informed by the selected and relevant models, thoughts, and faculty development strategies described below.

CEET Scholarship of Teaching Learning Community Model

Figure A.5.15:

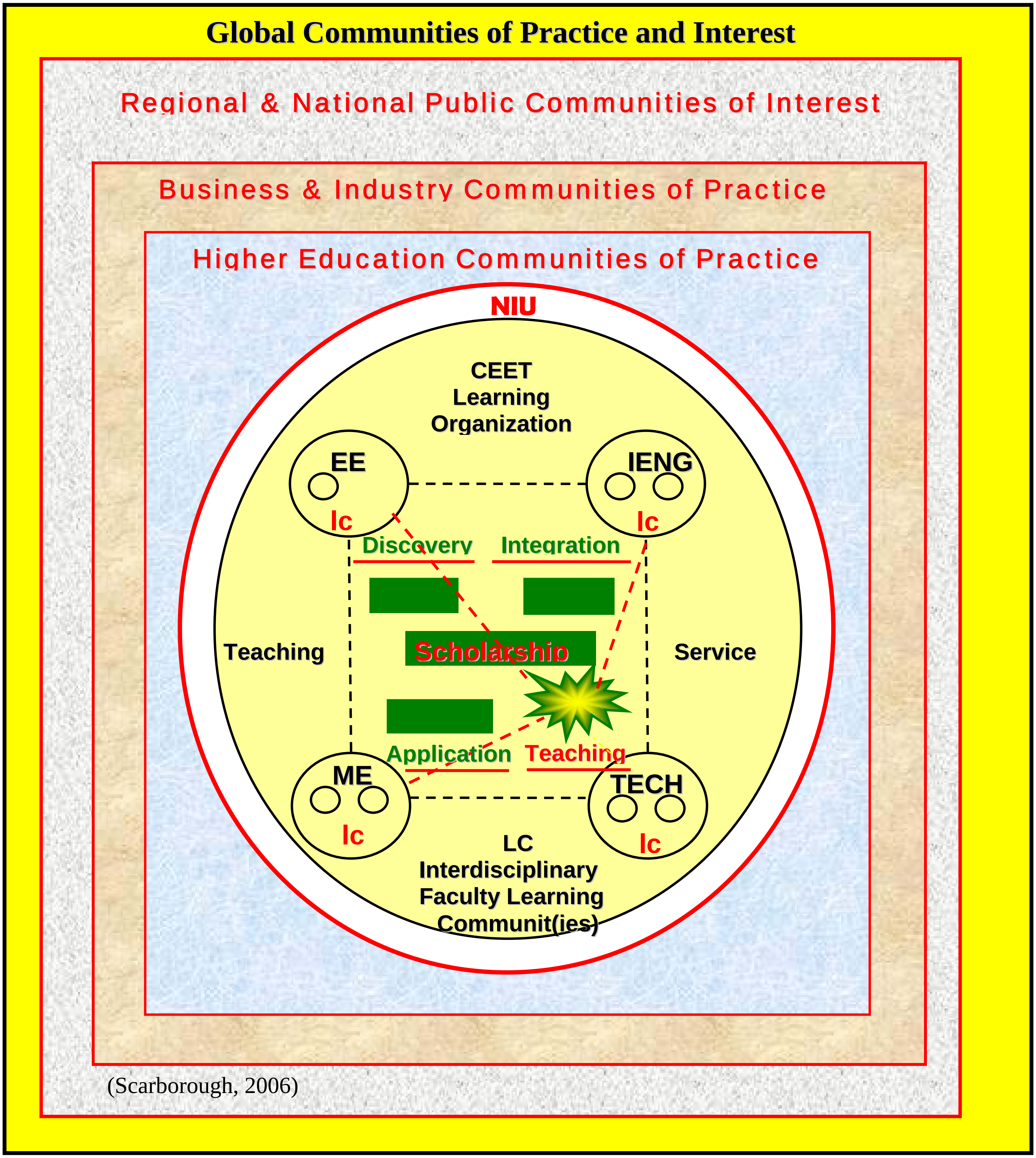
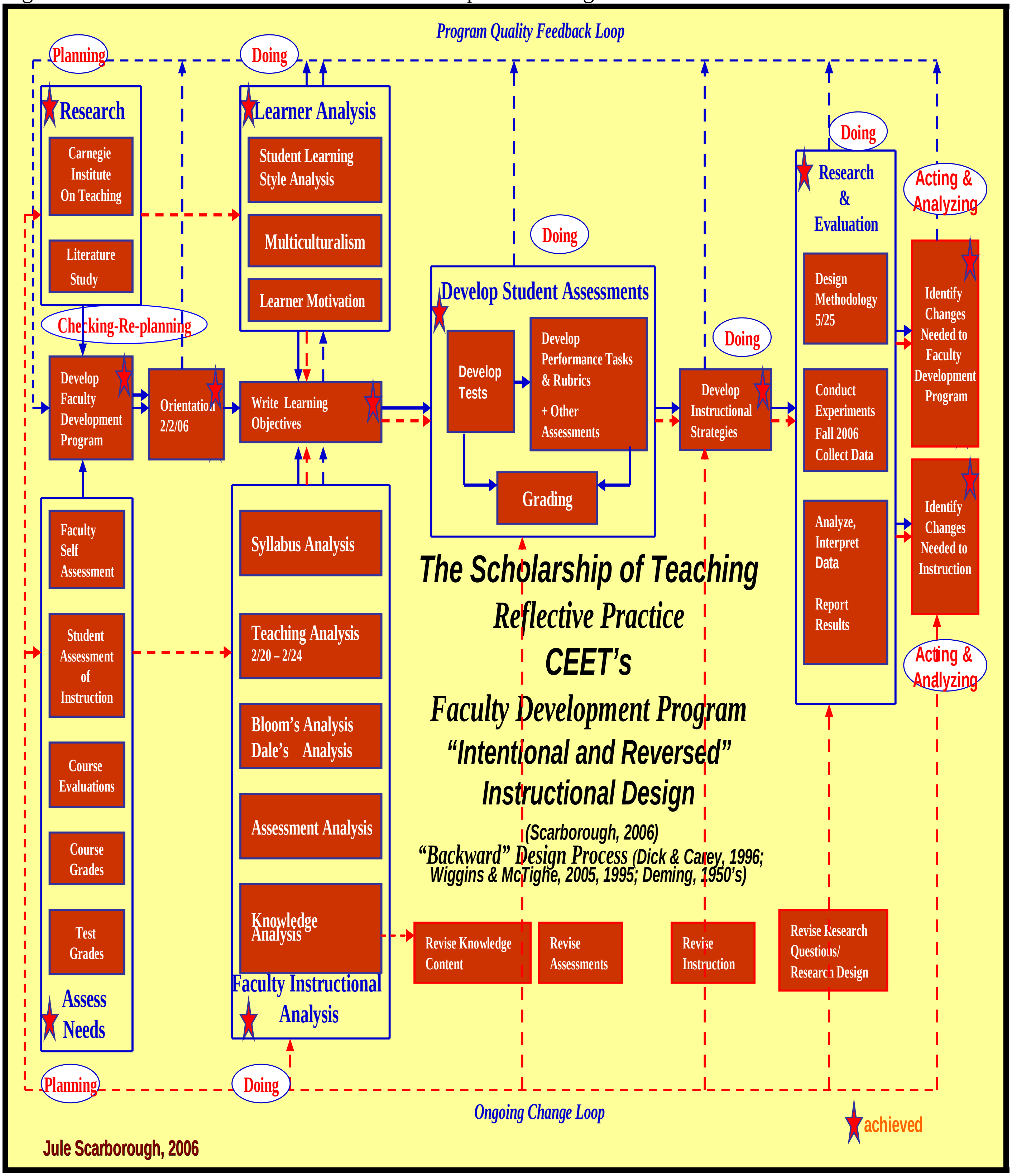


Figure A.5.16: Reflective Practice: The Scholarship of Teaching – The CEET Model



Reflective Practice for Educators - Change through Reflective Practice

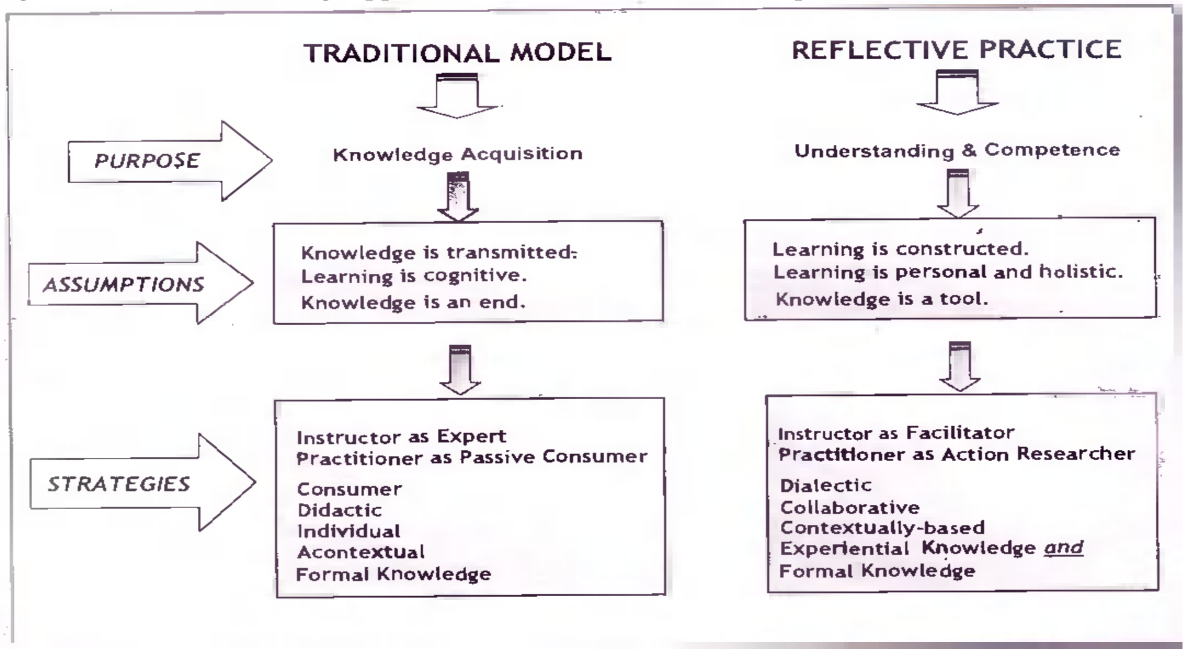
To us, reflective practice by our faculty members engages them in inquiry; it asks faculty members to consider their current reality; develop a vision and goals about what they would like to accomplish or change; engage in learning what is necessary to achieve the change goals; evaluate the effectiveness of the changes through research methods and procedures; and, finally, implement the changes that worked well. And for those changes that did not result in the desired outcomes to begin the cycle of inquiry again. This process, however, requires a kind of positive tension called for by Martin Luther King (1986) and mentioned by Senge (1990) as "creative tension," the energy that exists in the gap between one's current reality and vision – the desired future state of being. Reflective practice has no purpose without action; if one stops with describing the current reality without the action steps to move toward achieving the new vision (e.g., the identification of new goals, learning, evaluating, and implementing), then that reflection means very little. Thus, we have tried to provide a faculty development program to ensure that a complete cycle of change can take place by critically examining the current reality; identifying desired changes; studying the effectiveness of those changes through research and evaluation; and ultimately determining what to fully implement and what to study next. We created a learning community where faculty members can engage together for a richer process and result. In reviewing other models, we have learned that facilitators of professional development must first accept the following key assumptions and beliefs about those participating in the development (Osterman & Kottkamp, 2004, pp. 73-78).

Credo for Professional Development:

1. Everyone needs professional growth for opportunities
2. All professionals want to improve
3. All professionals can learn
4. All professionals are capable of assuming responsibility for their own professional growth and development
5. People need and want information about their own performance
6. Collaboration enriches learning and professional development

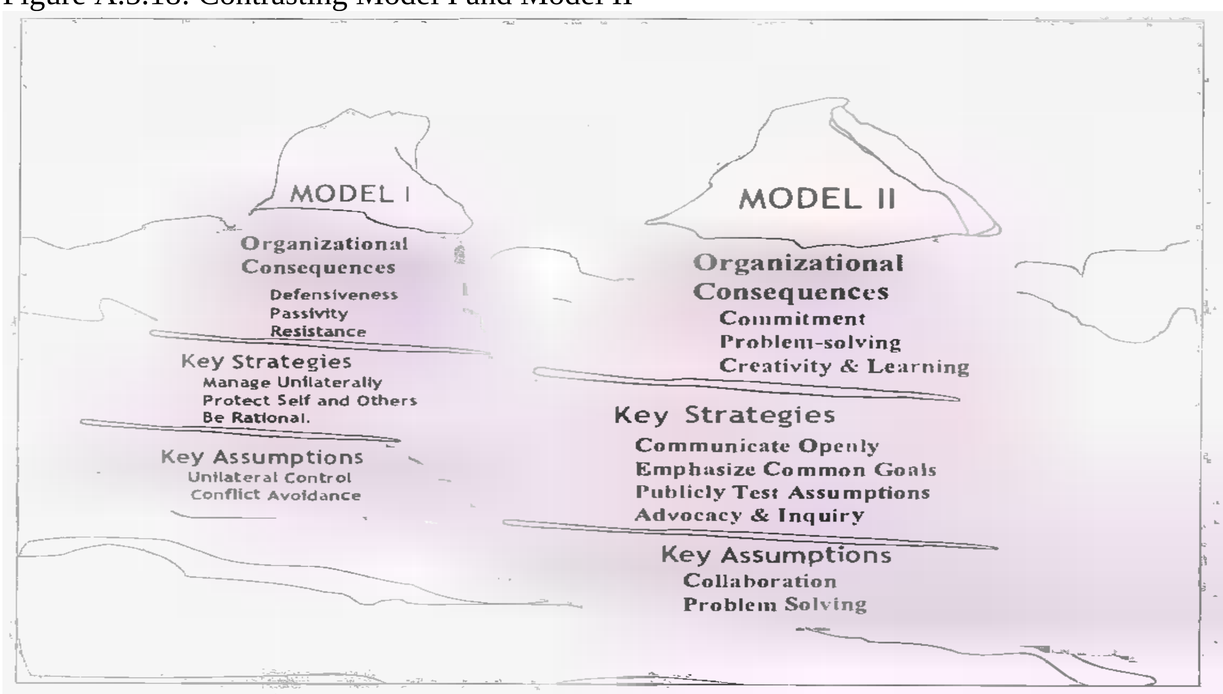
The models below compare traditional approaches to more collaborative and supportive approaches. Each reflects our goals for faculty development process and results.

Figure A.5.17: Contrasting Approaches to Professional Development



(Osterman & Kottkamp, 2004, p. 16)

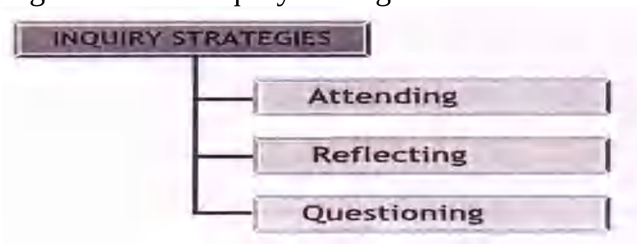
Figure A.5.18: Contrasting Model I and Model II



(Osterman& Kottkamp, 2004, p. 70)

The inquiry strategies recommended by Osterman and Kottkamp (2004) are attending to practices, reflecting upon them and their effectiveness, and then questioning what could be more effective or considering new practices that could have potential. Their processes and recommendations fit our initiative well, especially the analysis aspect leading to change.

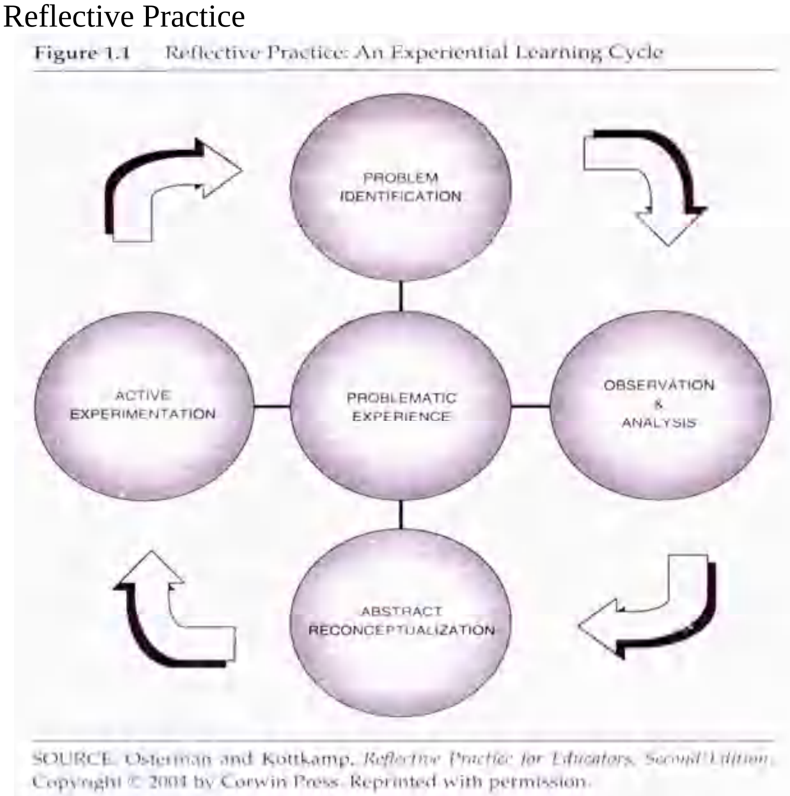
Figure A.5.19: Inquiry Strategies



(Osterman & Kottkamp, 2004, p. 83)

Sullivan and Glanz (2006) support the inquiry model of using problems as the basis for the inquiry. "Change and learning occur when a problem or <u>question</u> exists for which one sees [or seeks] a solution or answer" (p. 13). Our model has the research and evaluation built into it, and we have created a faculty learning community. Thus, our strategy and community environment reflect this model as well. However, the Sullivan and Glanz model reveals a process that is problem centered, identifying a problem upon which to focus the inquiry. We planned our approach somewhat differently; as noted above, our needs analysis revealed our strengths and weaknesses and areas of needed improvement. That information led us to develop desired, ultimately expected, outcomes. Therefore, we designed and organized the faculty development program and the overall initiative to achieve the desired outcomes. Our process was inquiry driven and the overall process reflects that of the Sullivan and Glanz model.

Figure A.5.20: Reflective Practice



(Sullivan & Glanz, 2006, p. 14)

Also we have created the community that Gladwell recommends. In agreement, we have tried to base our program, content and process, and faculty learning on research, established theory, and best practices relevant to our desired outcomes, using the best and most appropriate methods and procedures. We agree with Sullivan and Glanz that “to bring about a fundamental change…that would persist and serve as an example to others, you need to create a community around them, where these new beliefs could be practiced, expressed, and nurtured [safely]” (as cited in Gladwell, 2000, p. 173). “Envisioned change will not happen or will not be fruitful until people look beyond the simplicities of information and individuals to the complexities of learning, knowledge, judgment, communities, organizations, and institutions” (Gladwell, p. 213).

Perhaps we can assume that Problem Identification in the Sullivan and Glanz model includes generating a vision, goals, etc. Our process possibly differed slightly in that we first engaged in a needs analysis – survey research – to seek perspectives from students and professors about the “teaching” they were experiencing. This was the precursor to the identification of problems – or for us, outcomes to achieve. The Dean and Lead Professor generated a vision and goals for the college that the faculty accepted as a beginning point; then program leaders engaged participating faculty members in current practice analyses, and followed that by identifying teaching and learning desires, goals, and changes – defined in our program and college outcomes statements. These became our “problems” (outcomes) for inquiry in the model above. However, rather than focus so intensely on problems, although those were clearly identified in the analysis processes described in the program description, we focused more on the positive changes we would like to see occur regardless of how well we were teaching and students were learning. Yes, we do clearly understand our problems, but the more positive approach was one of identifying teaching practices that would increase learning by all students. Thus, we strategically identified outcomes that set the stage for purposeful change and continual improvement in teaching and student learning. We hoped this focus would keep us from getting too mired in the “problems,” and instead the focus on our outcomes would keep us centered and on what we wanted to change.

Also somewhat strategically, we wanted to generate questions on teaching and learning that would stimulate experimental research in the classroom. If we were to focus on “problems” from the perspective that people did things wrong all the time, it might have been difficult to move forward as quickly as we did. Thus, in creating a faculty learning community where the participants could identify strategies, models, techniques, or procedures on teaching and learning that they did not use (usually simply because they had no background), choose some to try, experiment in the classroom, execute some common changes that led to course improvements, and more, we focused on how to improve by directly addressing a myriad of problems (our program outcomes) without making the faculty members feel as if they were not professional or teaching well. By informing them about teaching and learning, we stimulated their interest and created the desire to try new ideas, strategies, models, and procedures. We hoped this would lead the professors to become aware of their research potential on the Scholarship of Teaching and that they actively would contribute to the research and bodies of knowledge on teaching and learning in higher education.

When striving to achieve, in one pilot initiative, the numerous outcomes we identified and the change process and program can be complex. Therefore, we tried to resolve some of the complexity issues before beginning the initiative. Kotter (1996) informs us by identifying the most common mistakes in the change process as (as cited in Dufour & Eaker, 1998):

1. Allowing too much complacency
2. Failing to create a sufficiently powerful guiding coalition
3. Underestimating the power of vision
4. Under-communicating the vision by a power of 10
5. Permitting structural and cultural obstacles to block the change process
6. Failing to create short-term wins
7. Declaring victory too soon
8. Neglecting to anchor changes firmly in the culture (p. 51)

Kotter (1996) and other leaders insist that successful change requires a sense of urgency. Without that, there will be minimal response. That lack of urgency or slow response has occurred regarding the call for the reform of K-12, and it took many years for schools and communities to take action. Now that there have been 10-15 years where the public has called for the reform of higher education, there appears to be a lack of sense of urgency. However, it is important to note that institutions of higher education have engaged in change for quality improvement (e.g., improved assessment and evaluation, teaching centers, and other changes). Whether these changes constitute a full reform movement in consideration of the issues regarding the relationship between teaching, student learning, and research might be a different question, but from an industrial perspective, the Kaizen process is very effective in that many small changes or improvements lead to great change and results over time (Goetsch & Davis, 2006). I believe this is where our strategy lies – to intrigue and motivate professors to engage in critical reflection about their teaching practices and student learning; then to follow through by identifying and implementing changes; and to complete the closed loop process by evaluating the effectiveness of their changes, resulting in a very different teaching and learning environment where the scholarship of teaching becomes important and recognized as an exciting and worthy academic endeavor. We envision the formal classroom research called for when Boyer (1990) and others defined the Scholarship of Teaching. Therefore, the change process we have begun involves faculty members in formal experimental classroom research as well as in formal evaluation of the faculty development model and program.

Change through Constructivism

When engaging professionals in learning new knowledge or in the development of new practices, the process should be no different than how we ask them to work with their students. Elsewhere in this document, we have accepted and advocated that our faculty members engage students in constructing their own knowledge through the learning process. Professional development should be no different; we should engage faculty in constructing their own knowledge and model in the professional development process, what we are asking them to do in the classroom. To review, constructivism means the individual constructs knowledge and it evolves as that individual evolves through six cognitive stages, building knowledge throughout the process of each stage. Piaget (1971) and Vygotsky (1934/1986, 1978) argue for social constructivism from the perspective that knowledge is constructed in a

socio-cultural context involving cultural tools and social interaction, which shapes individual learning and development. Woolfolk and Hoy (2003) believe that Vygotsky (most concerned with the development of the individual) bridges the social and individual and that individuals, by participating in activities with others, achieve individual outcomes through working together with others. Sullivan and Glanz (2006) agree that Vygotsky bridged the two perspectives, blending the social and individual. The learner "negotiates knowing…[and] stretches just enough to construct new knowledge slightly above the current level of knowledge" while engaged with another; through that support, the problem (or change) is solved (achieved) (p. 15). This has been identified by Vygotsky as "zone of proximal development (ZPD)" (Zepeda, 2000). The dual concept of individual and situated or social learning together (learning community) through reflective practice can lead professionals to construct self knowledge that will in turn facilitate the creation of the [improved] educational culture. Whether considering student learning or professional development,

> Reflective practice draws from constructivism, experiential learning, and situated cognition [in a relevant and social context]. Learning is an active process requiring involvement of the learner. Knowledge cannot simply be transmitted. For learning to take place, professionals must be motivated to learn and have an active role in determining the direction and progress of learning.
>
> Meaningful problems engage people in learning. Learning must acknowledge and build on prior experiences and knowledge. Accordingly, professionals need opportunities to explore, articulate, and represent their own ideas and knowledge. Learners construct knowledge through experience. Opportunities to observe and assess actions and to develop and test new ideas facilitate behavioral change. Learning is more effective when it takes place as a collaborative rather than an isolated activity and in a context relevant to the learner. (Osterman & Kottkamp, 2004, p. 16)

Therefore, we created a faculty learning community and engaged them constructively and actively in learning and development related to their individual disciplines, courses, and students using traditional assessments beside performances and the development of products for immediate classroom use with students. Thus, our initiative was social/collaborative, directly relevant to their disciplines and teaching, and constructive in learning and development.

Communities of Practice….Knowledge Communities

The transformation of knowledge within learning communities requires good communication of important knowledge if it is to be revealed, evolved and transformed. Important to this process is an aspect of group or team communication. If not very careful, and this very often happens, when groups convene to discuss something, problem solve, or engage in decision making, the content of conversation involves the expression of very "common" information. In other words, the knowledge presented by individuals is a great deal of common knowledge or knowledge that "everyone knows." It is important to note that real dialogue versus mere conversation ("new" information or information individual or <u>unique</u> to <u>each</u> <u>participant</u> that others in the group do not know because of different backgrounds, education, work experience, etc. across participants) begins to surface. That is when more important and

knowledge new to each other becomes available for the group to consider and exploit for their positive purposes (Goestch, 2006). This is when both individual learning and team or community learning leaps to become greater than the sum of the number of members involved. As Senge (1990) notes, team learning is greater than the individual learning that occurs among team members. This is similar to the interaction effect often associated with research. When two treatments are applied, there is also a result of the interaction of the two treatments, not just a result of each treatment individually. With teams or communities of learning, if sharing knowledge known individually rather than repeating commonly understood knowledge, there is first greater learning by individual members and then exponentially greater learning by the team or community.

Our knowledge economy is often linked by organizational researchers to "communities of practice." These communities are where reflective practice lives. Communities of practice are described as

> companies [for us the university] at the forefront of the knowledge economy are succeeding on the basis of communities of practice, whatever they call them…Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis. (Wenger, McDermott, & Snyder, 2002, p. 4)

Knowledge community beliefs involve

- Knowledge lies <u>less</u> in its <u>databases</u> than in its people (Fullan, 2003, p. 121)
- For all information's independence and extent, it is people, in their communities, organizations, and institutions, who ultimately decide what it all means and why it matters (p. 18)
- A viable system must embrace not just the technical system, but also the social system - the people, organizations, and institutions involved (p. 60)
- Knowledge is something we digest rather than merely hold. It entails the knower's understanding and having some degree of commitment. (p. 120)

Building a learning community involves the development of organizational and personal visions articulated through statements that can communicate to the community at large. These should be simple and brief, although they are usually far too long when developed by educators. Those participating in communities need to be trained and/or educated about group dynamics, communication, and conflict resolution and in the use of what might be perceived as corporate techniques (e.g., force field analysis, fishbone process, double reversal process, rating and ranking, and using the pieces of the pie process, etc.) (Sullivan & Glanz, 2006).

Applications in Higher Education

Universities are organizations whose communities of practice across its disciplines are both disciplinary specific and common. Of course each discipline has its own body(ies) of knowledge and particular practices and although there is certainly integrated knowledge and practices across disciplines, most view individual disciplines as separate from one another. However, the common knowledge and practices that should exist across learning institutions,

whose goals are to engage in research and also to teach, are about research, teaching and student learning. Therefore, a common and interdisciplinary professional activity should be research about teaching and student learning. Universities are complex organizations because these institutions and its professionals bear the responsibility of contributing to the knowledge and best practices of specific disciplines, but they also bear the responsibility of adding to the knowledge about teaching and learning. It then makes sense for each unit to have a teaching and learning aspect of its vision, aligned beside the vision that usually includes disciplinary research and service. This then widens the many disciplinary learning communities and their respective communities of practice to include a teaching and student learning vision, which directly impacts one aspect of the community of practice with which they are engaged, and also the communities of practice they are sending their students into, the employers of our graduates.

In establishing what we want to accomplish with our faculty learning community and how we want to go about it, we further reviewed the work of others in the hope it would confirm or inform our initiative. Information from the literature is woven throughout the entire document where relevant. Below, however, literature is reviewed about the professional development of faculty as well as information from the university national network, Professional and Organizational Development Network (POD).

Professional Staff Development Models

Fraser (2005) provides a concept of development that addresses both development of the <u>environment</u>, which includes organizational mission, goals, plans, strategies, structures, and support systems, as well as quality assurance and improvement measures and the development of the <u>academics</u> and others who play a role in facilitation of learning. This approach to developing the *whole* environment is termed "educational development" within universities. In defining today's context, Lines (as cited in Fraser, 2005) indicates that a paradigm shift had to occur between the industrial and information ages. This resulted in a shift of universities from a regional to a global position. Therefore, the work of academics became everything from “teaching on campuses locally, in foreign countries, to collaborative research, and development across national boundaries, to conducting 'virtual' classes with students in a variety of locations” (p. 7). Fraser and Lines go on to discuss accountability and the pressure from the public on higher education as discussed above, the changing nature of universities, the outcomes oriented era, and finally acknowledge that teachers are still in front of students in the classrooms lecturing to a group of students. Courses are still on a semester or quarterly basis for credits; there is a growing use of online courses and distance learning; and there is a growing range of choices for learners as to time, place, and pace of learning. Clearly, the point is that the academy that facilitates learning involves more than scholars (p. 13). Assuring and improving teaching quality has become a university issue. In the context that academics identify first with their discipline and second with their departments, regardless of institutional quality issues, the challenge for educational development is to help academics think about their teaching differently. Quality is not as easily defined for teaching and learning; quality assurance language as used in business may not quite fit. However, as a form of action research, it may resonate with some, while alternate forms of quality in terms of the language of scholarship may work for others. From there, we move on to achieving commitment, ownership, and trust if we are to engage in ongoing change; there must be

commitment at all levels, faculty to administration, and beyond any stakeholders who may support that change. "Building change into university practice," transformative change, "the task of ‘doing quality' needs to be built into the life of the university and incorporated in taken-for-granted university practices" (Patrick & Lines as cited in Fraser, p. 35). Resources need to be allocated for

> dialogical support…collaborative support for groups of staff working on educational change projects… [for example] adopting new ways of representing knowledge and conceiving of the relation between teachers and students. The change process will challenge the epistemology, professional identity, and established practices of many academic teaching staff – in fact, it involves cultural change within academic departments" (p. 35; see also Martin, 1999; Prosser & Trigwell, 1999; Ramsden, 1998b; Trowler, 1998).

The model these authors propose uses critical reflection, action research as inquiry to determine needed changes. They provide for sharing of experiences across cultures and teaching environments, and they suggest that traditionally used short term teaching development projects or central activities in which people participate have not been particularly adept in accomplishing or supporting transformational change. Patrick and Lines feel that a more successful approach to quality is needed in which group development and learning "snowball" and ultimately result in a learning organization that “creates a coherent, supportive environment that is dialogical and open to experiment and development” (as cited in Fraser, 2005, p. 36; Martin, 1999; Senge, 1990). These authors reveal the details and issues of the creation of their quality system that reflect and confirm our own model. Chalmers and O'Brien (as cited in Fraser, 2005, p. 51) discuss how today's practitioners need to have a working knowledge of the socio-economic, cultural, political and philosophical context as points of reference for their professional practice. They present four overarching concerns as the primary foci for educational development today:

1. maintaining a corporate memory of, and sustained engagement in, the issues and innovations in teaching in higher education. Central educational development units, or centers of teaching and learning, can be used as the "site of corporate memory of previous research, innovations, practices as well as policy directions in teaching and learning…It also can encompass the ongoing and local developments and teaching and learning initiatives.” (p.55)

2. engaging in comprehensive and systematic implementation of teaching and learning initiatives. Central educational development units can stimulate relationships between departments. Currently, some universities are moving "back" to the model of providing their own professional development, as they are not satisfied with what is offered by the central unit and feel it does not meet their specific needs. Conversely, departments are criticized as not addressing the teaching needs; more often, research is the focus. Even when formal programs of development are available, it is difficult to get faculty involved as the pressures of research, teaching, administration, and service are great. And although participating in teaching development programs are considered "good to do," often faculty do not find the time to participate.

**Our model is decentralized in that the College is the provider and only its faculty members will participate. We have a university office for professional development; however, we had needs that could not be accommodated nor was any resource support available or provided. Therefore, we can strongly relate to number 2 above.

3. creating and facilitating communities of learning involved in the iterative and dynamic top-down/bottom-up engagement and management of educational initiatives. Many centralized educational development units are participating in institutional decision making and managing requirements for development and structures and strategies for carrying out the development. This can cause problems in being viewed as too top-down and disconnected from or imposing work on departments or individuals. These issues can be resolved through discussion about what works and what is beneficial and needed and then by actively engaging faculties, schools, and programs in initiatives or projects that are responsive to departments' needs - situated projects and activities where the departments or faculties identify these projects. The aim is to engage staff in team- or project-based activities that will have an educational outcome – staff development and/or student learning.

** This is exactly where our initiative lies in some respects. We have an interdisciplinary college level learning community comprised of disciplinary learning circles. The initiative is collective and team oriented. We are fully supporting the initiative, so that is where ours differs. The NIU educational development unit decided not to assist in funding our initiative; and the Provost's Office provided no funding for this initiative. The Dean's Office for the College provided approximately $100,000 of real funding (includes faculty stipends), course release for the initiative leader, a part time graduate assistant, and other learning materials and supplies (e.g., books, flash drives, lunches, etc.).

4. investigating, articulating, and dissemination of scholarship in (and on) teaching, learning and education development. The emerging emphasis on scholarly teaching and learning shifts the point of reference for development on teaching and learning and for scholarship. University teachers, professors who teach are increasingly actively engaged in the scholarly development of their own teaching for the purpose of researching what teaching strategies succeed in enhancing or increasing student learning, interest, and motivation. This enhances the learning community, including the faculty and student aspects of that collective community.

**Our faculty engaged in classroom research and will disseminate the results. The research goes beyond informal action research; it is formal experimental research. However, it is action oriented in that it will lead to greater understanding about what to change in the teaching and learning environment and teaching practices. Therefore, our model incorporates faculty development on teaching and learning, scholarship through classroom research, critique or critical reflection about practice, and <u>transformative change,</u> both individually by professors and collectively as a learning community.

> **Our initiative engaged us in another formal prong of research, for we designed the initiative to incorporate research on the faculty development model and program as well. There was a strong feedback and evaluation plan resulting in evidence about the model, program, and process success. (See Results B.0 – B.12) Our model involved faculty members in building a knowledge foundation on teaching and learning; it supported them through the development of educational products to use in the classroom, as well as to make more informed instructional decisions about teaching, and then also supported them to engage in experimental research in the classroom, using what they learned in the program. Thus, the program supports individual learning, community engagement and learning, learning through individual and community collaborative research, ultimately resulting in cultural and environmental changes for teaching and learning in the college. We will now move to sustain the pilot initiative momentum to sustain continual changes through the new framework, structure, and program.

Patrick and Lines (as cited in Fraser, 2005) have determined that educational development is most effective if the central university is the unit of engagement rather than the more traditional and decentralized departmental approaches.

**Our model falls somewhere in between, as we engaged as a college unit involving four departments. We will share our results with the university and broader communities. Having determined that the university approach is best, the authors also clearly believe that the ultimate responsibility for the quality of teaching and learning lies with the staff who teach the students, the faculties who offer the programs of study, and any support staff. But Patrick and Lines's central belief is that for transformative change in the quality of teaching and learning to be sustained, it will be more effectively achieved through a holistic and integrated effort (university-wide). We feel that our college unit approach is somewhat holistic and integrated.

A second belief of the authors is that partnerships should be developed to engage in the tasks of scholarship of practice while maintaining the integrity and authenticity of each discipline so that layers of interaction develop across the university.

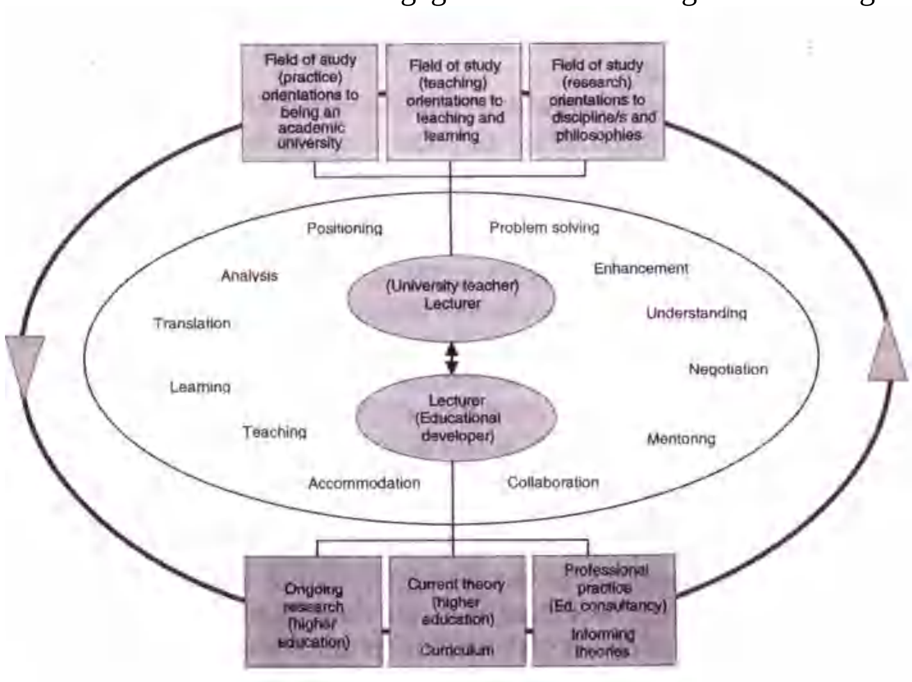
**We, too, believe that we are doing this. We have four types of degrees, five programs, accredited by two accreditation agencies.

Third, Patrick and Lines (as cited in Fraser, 2005) conceptualize the educational development unit as a dynamic conduit and agency of negotiation of what counts and is valued as high quality teaching and learning and the resulting policies thereof. Their concept is a centralized educational development unit that provides ongoing leadership for the task of developing and enhancing the quality of teaching and learning in universities. Many universities now have these units known as Teaching and Learning Development Offices or Centers for the Enhancement of Teaching and Learning. They, and many others, offer a conceptual model of communication and collaboration as central to ongoing development university wide.

**In my opinion, NIU and many other institutions, have accomplished joint involvement in professional development modules, workshops, seminars; there is some sharing through

communication at such events, but NIU, and many others, has not yet achieved real internal partnerships with interest in the Scholarship of Teaching, practice, or campus-wide collaborative initiatives focused on research and/or changes in teaching and learning. Therefore, we determined it best to seek support from the central unit, but because our scope was beyond their support, we moved ahead on our own. The O'Brien (2004) model is presented for review.

Figure A.5.21: Model of Collaborative Engagement for Teaching and Learning



(O’Brien, 2004 as cited in Fraser, 2005, p. 54)

Radloff (as cited in Fraser, 2005) presents the issues involved in engaging in the improvement of teaching and learning:

- how to motivate staff to engage with the task of continuous quality improvement;
- how to facilitate and support staff capability building in teaching and learning to allow them to engage effectively in quality improvement activities;
- how to support improvement activities as part of continuous quality improvement, including the resourcing of such activities;
- how to evaluate the effectiveness of improvement activities;
- how to recognize and reward positive outcomes;
- how to support the Boyer Scholarships, especially the Scholarship of Teaching and Learning; and
- how to maintain a cycle of continuous quality improvement (amongst other priorities) with limited resources.

** As mentioned herein, we managed to motivate and reward the participating faculty members. However, long term motivation toward continuous improvement in teaching and student learning may be a different matter. The faculty participants of this first round, our pilot initiative, were focused, productive, dedicated, and stuck with us regardless of what we

asked them to do beyond the 18+ days of real time and the research semester. But to sustain the pilot initiative activities so that "continuous" quality improvements will take very specific and visible leadership, organization, and continuous building and support of the faculty learning community. So although we accomplished a phenomenal list of outcomes and have data to support the reporting of those accomplishments, sustainability will now have to be addressed quickly so that the initiative does not lose momentum.

**Regarding resources, it is our intent to submit proposals to agencies for funding to expand and deepen our initiative, not only to others in the college, but to other institutions. Therefore, one of our sustainability activities is to produce a proposal to the National Science Foundation and other agencies for support to further the initiative in several major ways:

- To provide the faculty development program to all faculty members interested in the College
- To initiate a regional learning community across universities of similar interests
- To extend the initiative technologically by virtual activity so more serious sharing and research could occur by members of the regional community
- To include in our overall program, teaching, and student learning evaluation activities additional components for ongoing evaluation as a result of what was learned through this program and initiative
- Although our bylaws already inherently support and reward research on teaching and learning, we seek to move toward adopting standards for all four types of Boyer's research so continuous improvements of high quality can be more easily recognized and rewarded.

**Support will have to be generated long term internally; that can occur through the reallocation of funds, through the personnel review process, and through the Provost's Office. We already have several teaching and research awards. The university Presidential Research and Teaching Awards come with $20,000 and a semester sabbatical in addition to usual sabbaticals. The College has awards aligned with those that provide travel to a major conference and often fund special resource requests. So we have acknowledged the importance of rewarding excellence. To me, however, one step remains, and that is that anyone who achieves the quality standards be able to receive those awards upon attaining the standards. At the present time, we are limited to six Presidential Awards, three in each category, and one in each category at the college level, unless there is a tie. I would rather see the number not limited so that when achieved, faculty members are awarded.

**Top level and visible leadership at the Dean and Department Chairs' level is absolutely critical for this initiative to continue.

**Finally, the faculty learning community must have committed and very active faculty leaders who lead, manage, organize, hold faculty accountable, and continue to stimulate the excitement that is needed to sustain action by the LC.

Radloff goes further to identify the capabilities needed for quality teaching and learning (as cited in Fraser, 2005, pp. 76-77; Taylor, 2003):

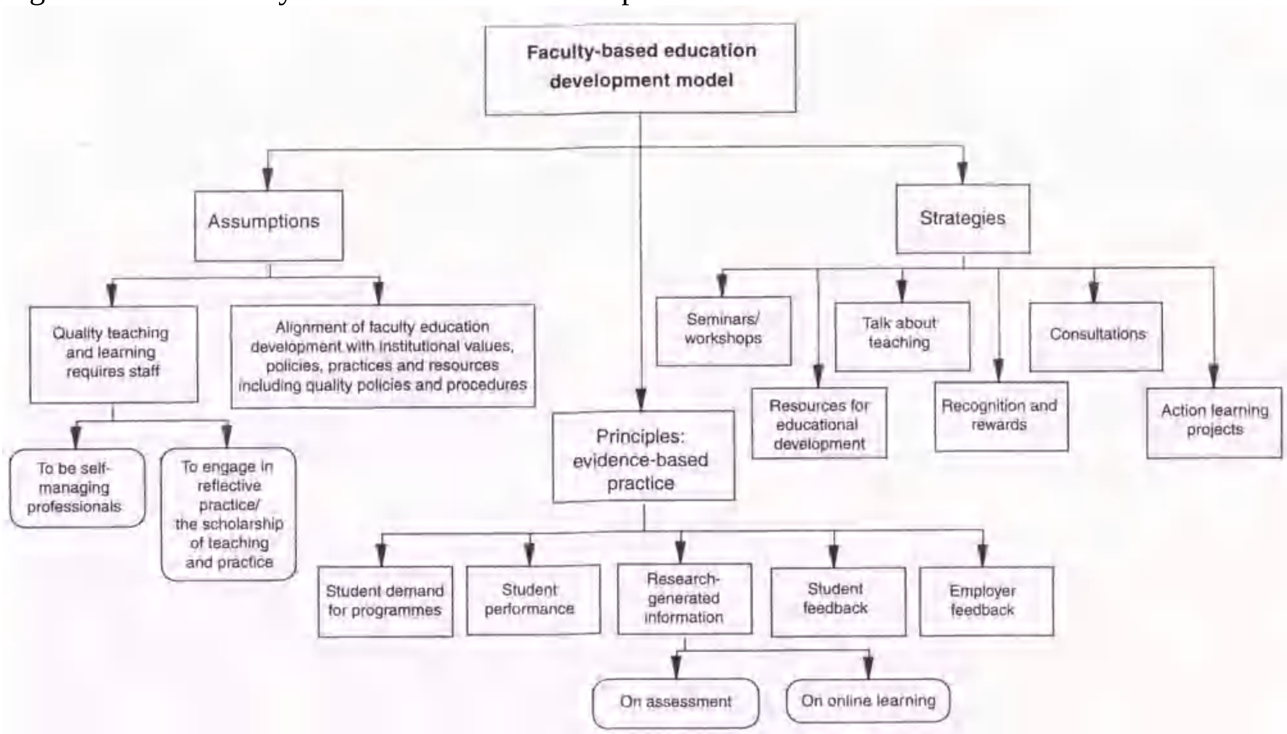
- Engagement locally and globally
- Engagement with peers and colleagues
- Equity and pathways
- Leadership
- Engagement with learners
- Entrepreneurship
- Designing for learning
- Teaching for learning
- Assessing for learning
- Evaluation of teaching and learning
- Reflective practice and professional development
- Personal management
- Management of teaching and learning

**In response to Radloff's list, most of the items have been incorporated into our initial model, program, or process. However, one item is worth some discussion and is sometimes critical to teaching: student learning and what is possible in the classroom, especially if the professor has a desire to accomplish the teaching and learning outcomes of our focus. Our faculty members are not what I would label as "entrepreneurs." Although they work with industry on contracts and lead research or development grants, when it comes to funding teaching or student learning interests, in my opinion, they do NOT consider that their job. Personally, however, I have found it always possible to get funds for research on teaching and learning, funds for classroom supplies, materials, and technology for more innovative projects. For example, I have long had a strong relationship with an engine company. The company donates 20-30 high powered engines regularly when needed. We use them until they function no longer and try to respect the company by using them in every way possible for projects, inquiry, and testing to extend the time before making another request. The students, professor, and graduate assistants provide the company a full report on our projects and results each semester from with pictures and project goals and results. This has allowed me to keep the lab fees lower, to engage students in complex problem based learning, and so much more. This, although simple and only one example, is one entrepreneurship. Generally, professors do not feel that it is their job to seek funds, technology, equipment, engines, etc. for teaching and learning purposes, although many are very successful for academic or contractual research and development.

**The Dean has recently employed a full time staff member to develop grant and contract opportunities. The position is new and not fully evolved in definition. It is possible that he will include "entrepreneurship" for teaching and learning purposes in the classroom with students as part of the individual's responsibilities.

The following figure reveals the relationships in Radloff's model. There is a direct line to principles: evidence based practice obtained through research generated information. Otherwise the model reveals the relationships between assumptions and strategies for change.

Figure A.5.22: Faculty-Based Education Development Model



(Radloff as cited in Fraser, 2005, p. 81)

Radloff (as cited in Fraser, 2005) discusses Teaching Quality Awards where

> the aim is to recognize and reward staff who have made a significant contribution to the faculty goals in teaching and learning; raise the profile and status of teaching and learning in the faculty; provide an opportunity for staff to share their knowledge and skills about teaching and learning across the faculty; and encourage and support staff to nominate for the University Teaching Awards (p. 84).

**I am pleased to say that both the College and NIU have such awards, as mentioned above. And beyond that, the faculty participating in this initiative will receive monetary awards to recognize the great amount of time they engaged individually and together to achieve the initiative goals and formal products, research, and dissemination activities they committed to and have accomplished. We cannot begin to pay them for their level of effort and time, but what we have been able to do is to offer a significant stipend, to use some regular weekdays during the semester (in addition to some after summer begins), and to provide important resources such as books and other supplies. The professors received a certificate of completion for the program, and some of them received special resources to support learning activities during the research semester. For example, two faculty members needed the Kolb Learning Style Inventory for all their students; the Dean purchased them. He also arranged special learning space requests and more. The support received was more than reasonable, and recognized their commitment to the endeavor, however, less than what our faculty can earn as consultants during the summer or make on their grants. As they noted, they are not in this for the monetary rewards; they see the value in the program and research to follow, and it seems they are genuinely interested in the scholarship of teaching. However, although we had teaching awards established before our initiative, there has not really any vehicle for

sharing knowledge and skills across departmental faculties, and even at this point across our initiative, so the sustainability of that process has yet to be fully structured. The “internal dissemination” will begin to occur with presentations by initiative participants during fall semester 2007. We are hoping that the formalized LC structure will be revised and scheduled by the community before Fall 2007 to continue learning, research, and sharing activities. We are hoping that they will all participate in seeking grants together. This will be strongly supported by the Dean.

Evaluation occurred in two ways, as we have a two pronged research effort involved in this initiative. We researched the value and effectiveness of the professional development model, program, and processes, and each participating faculty member researched the effectiveness of selected teaching strategies and new student assessments on student learning. Therefore, there are layers of evaluation embedded within our model that are more thoroughly discussed in the research section. Radloff (as cited in Fraser, 2005, p. 85) provides a list of what he (and his colleagues) feels would constitute useful evidence for determining the effectiveness of any educational development effort. They use Kirkpatrick's (1998) approach, a four-step strategy: satisfaction, learning, application, and impact and then mapped out what, for them, would constitute useful evidence:

- positive staff reaction to support and professional development opportunities in the form of feedback surveys, information comments, participation in activities and return business (satisfaction);
- increased staff confidence and competence in teaching and learning through self, peer and student evaluation (learning);
- improved teaching and learning practices at program and course (subject) levels, as evidenced in the design of learning activities and assessment tasks, self-reflection and peer review (application);
- improving student performance, as evidenced by reduced attrition rates, increased progression rates, and enhanced learning outcomes (impact);
- increasing student, graduate and employer satisfaction with learning and learning outcomes (impact); and
- improving program performance in terms of the university's “business rules,” namely quality (student and graduate satisfaction), relevance (employability of graduates) and viability (demand for the program and cost-effectiveness)

**Our evaluation results indicated that the professors were extremely pleased with the model, program content, and process. They indicated that it would not be reasonable for most faculty members to commit to the number of days of faculty development. However, now that we have piloted the program, it is possible to condense some of the activities without losing quality. Also all of the materials are now prepared for the fundamental program components. These will need updating but not total redevelopment for another program offering. Other new components may be developed as the faculty members ask for some additional topics to be available later (e.g. more time on cooperative learning, student teaming, and classroom and conflict management). The cooperative learning component is already developed as well as a very thorough program on student teaming.

**We have set the stage for ongoing evaluation; it is more a matter of what direction the LC now takes as faculty members begin to lead the LC. The leader has been a faculty member, but she has retired; therefore, other members will take on the leadership. Several are interested.

**We have set the stage for long term and continuous teaching, assessment, student learning, etc. changes. The participating faculty members have a tool box of resources at immediate hand, each individually, for this purpose. Not only do they have what they have already developed, but they have the knowledge, tools, and additional information to support their long term and continued growth and changes.

**Initiative <u>sustainability</u> is critical and is the only way to provide evidence of several of Radloff's listed types of evidence: employer satisfaction, increased student learning; improved program performance, and graduate satisfaction.

Although a much earlier model, Zuber-Skerritt (1992) offers a model that integrates educational theory and teaching practice through action research; our model does this as well. He defines action research as CRASP, where "critical (and self-critical) collaborative inquiry by reflective practitioners being accountable and making the results of the enquiry public, self evaluating their practice and engaged in participative problem-solving and continuing professional development (p. 19). Each component is described in the table below.

Table A.5.18: The Case in Relation to the CRASP Model

C	Critical attitude	Critique of status quo in practice and context.
R	Research into teaching	Identifying and solving problems in the curriculum and student learning through a spiral of action research cycles (plan–act–observe–reflect).
A	Accountability	Intrinsic and extrinsic: justifying the academic value of practice and publishing the theories and practices of the work and situation.
S	Self-evaluation	Self-reflection and self-evaluation as part of the teachers' research into their own teaching, inviting students and others to provide critical comments.
P	Professionalism	Professional development through action research; professionalism encompassing the above four requirements.

(Zuber-Skerritt, 1992, p. 20)

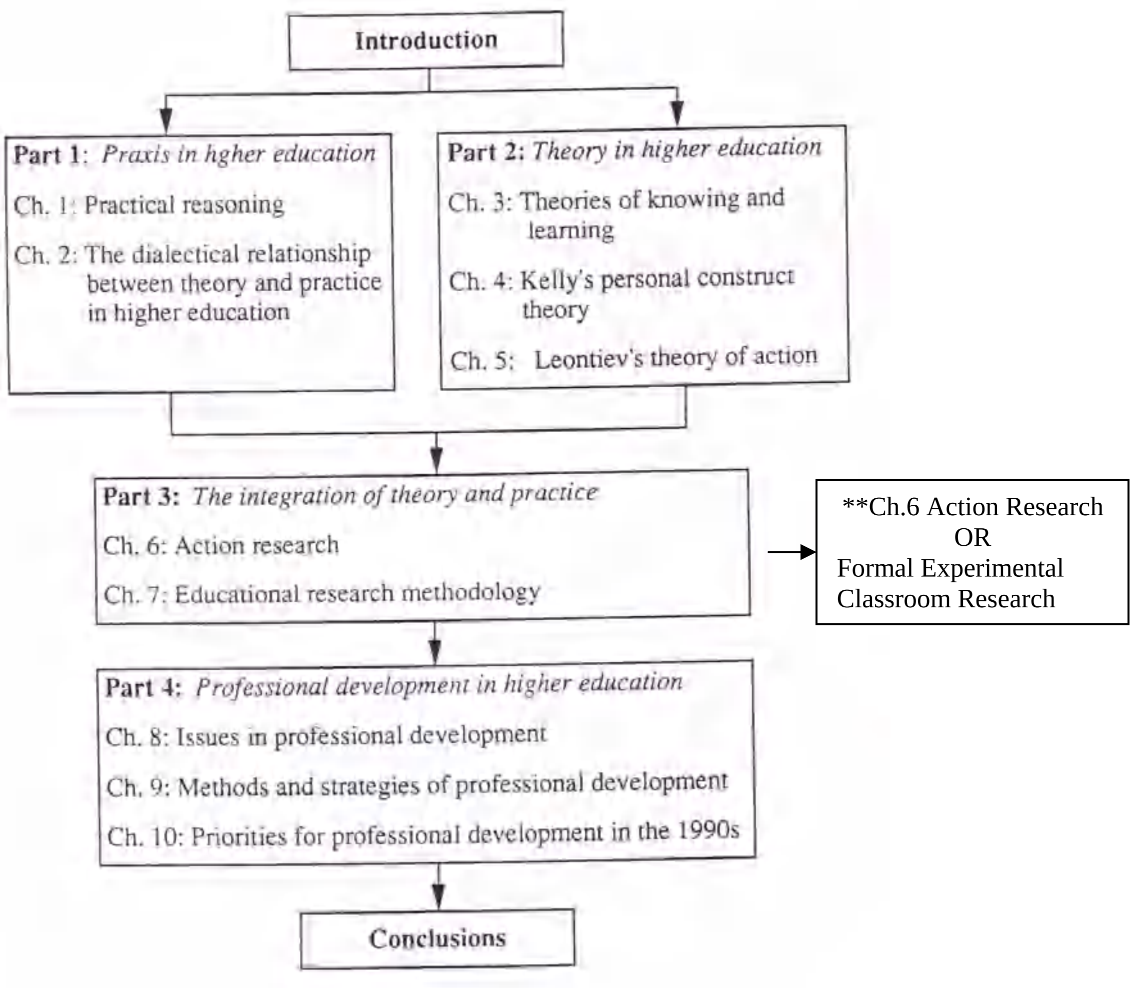
Also reflecting our initiative as well as informing it, Zuber-Skerritt (1992) provides a theoretical framework or meta-theory grounded in other previously unrelated theories on teaching and learning, etc. He establishes the gap between theory and practice, acknowledges the vast amount of research on student learning and teaching methods, and further admits that literature has had seemingly little impact on the practice of teaching because most professors

have not had any professional preparation for teaching and normally do not access all the books, literature, research on the topic as it seems irrelevant to their endeavors. They are not comfortable with the jargon and terminology used in educational/psychology and feel it somewhat pretentious.

**This, in fact, was the reaction by at least one or more or our participating professors. The comment(s) went something like "so many terms that have the same meanings, etc.," when in fact there were subtle differences that were not easily grasped by those who had not been exposed to the evolution of concepts or terms such as learning objectives or learning outcomes or behavioral objectives, etc.

Zuber-Skerritt's (1992) model is presented more fully below, and although different as a visual or representational graphic and more broadly presented, it reinforces our direction. His book is outlined in the first graphic; the models reflect various authors' perspectives. Each of these serves to confirm and inform our direction, model, and processes.

Figure A.5.23: The Structure of This Book [as a professional development model]



(Zuber-Skerritt, 1992, p. 20)

** Our comment.

Part 1: This model (Figure above) component addresses the basic assumptions about the connection between theory and practice: that relationship is perceived more as a dialectical relationship than a dichotomy. Practical reasoning is the bridge over the gap between theory and practice. Zuber-Skerritt's (1992) aim is to show the relevance of the theories to practical and emancipatory action research for change. His action research spiral is to Plan, Act, Observe, and Reflect, not unlike the Deming's Quality Circle (1956 - industrial), plan, do, act, check, or the revised one, plan, do, check, act, analyze (Goetsch, 2006, p. 19).

Part 2: This component provides the theoretical basis that presents the opportunity and supports Zuber-Skerritt's (1992) view of how to improve teaching and learning in higher education. This component is the foundation for the model structure of staff development and student learning.

Part 3: This component serves to integrate theory and practice such that one supports the other. It then drives the fourth component, faculty development. However, this linear approach might be questioned as to which comes first, faculty development or research. With professors who have no background in teaching and learning, it would be difficult to integrate the theory and practice without first engaging them in faculty development. Perhaps this would be necessary only initially.

Part 4: This component reveals the focus on faculty development, but we found that faculty development was needed to reach the initial point to be able to integrate theory and practice. There is a need with those who have no background in teaching and learning to achieve some fundamental understanding of the theory before being capable of research. Also educational research is quite different in nature than the engineering and technology type of research our faculty are used to performing.

**Although an older source on faculty development, Zuber-Skerritt's (1992) model certainly relates, reflects, and supports our initiative. Program content, process, and the overall model are reflective of his support theories, model for taking action, methods and strategies for professional development, and more.

Esland (1971) also reflected our faculty development goals, as well as what we hope will happen in classrooms with students (as cited in Zuber-Skerritt, 1992). Although somewhat generic, the focus on learners being "active" and "negotiators of meaning," where one engages in the "construction of knowledge and experience," etc. resonates with the theory supporting our operation premises. (See Literature section A.6)

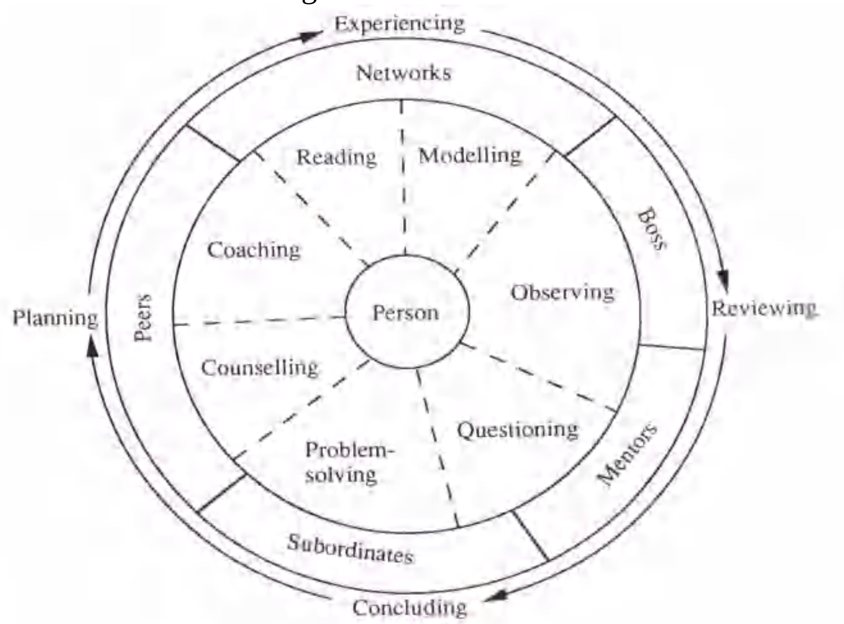
Table A.5.19: The View of Humankind in the Traditional and Dialectic Epistomology

Traditional epistemology	Dialectic epistemology
Humankind as	
Passive receiver of knowledge	Active seeker and negotiator of meaning
World-produced	World producer and social product
Having a static, analytic conception of knowledge	Being involved in an active construction of knowledge and experience
Believing in truth and validity of knowledge	Believing in changing forms and content knowledge, open to sociological revitalisation
Regarding teaching as the acquisition of skills and techniques to transfer knowledge from teacher to student	Regarding teaching as active knowledge and reflective understanding of curriculum pedagogy and evaluation

(Esland, 1971 as cited in Zuber-Skerritt, 1992, p. 35)

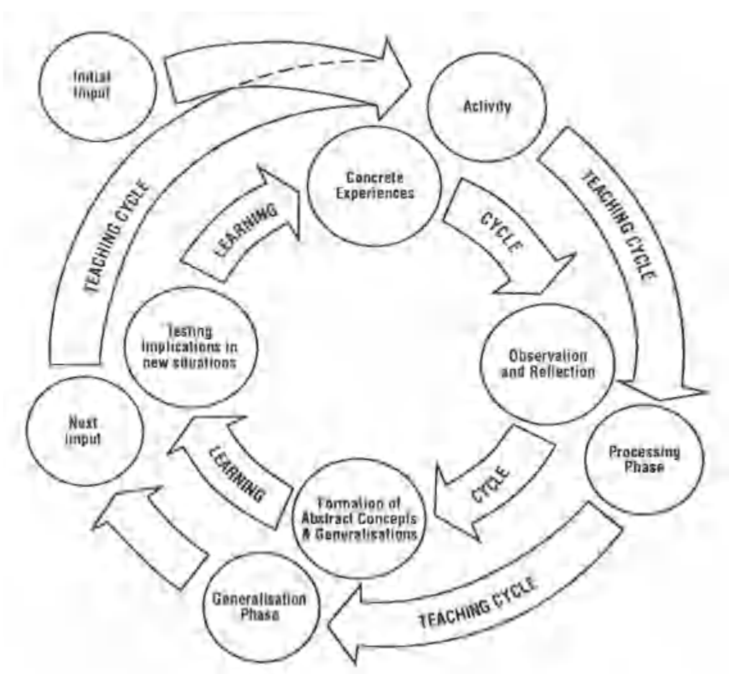
The elements of Mumford's (1990) and Boud and Pascoes (1978) (as cited in Zuber-Skerritt, 1992) models below are directly in line with our goals and outcomes for this initiative. The learning environment reflected in the Mumford model, especially where relationships are represented and where the process of planning, experiencing, reviewing, and concluding are the context within which the relationships function through a wide range of activities, certainly also resonate with our model, program, outcomes, and results. The process represented in the Boud and Pascoe model, where individuals experience, observe and reflect, form abstract concepts and generalizations, and test in new situations follows the lines of action research or, as in our case, formal experimental research. The teaching cycle phase seems to represent informal or action research more than more highly formalized experimental research. However, we want to stimulate our professors to understand that both informal and formal and both action research without controls or experimental research with control groups are equally valuable for testing new ideas, theories, strategies, etc. in the classroom about teaching and learning. We would hope that the professors engage individually and together using both strategies and a wide variety of methods and procedures. We can directly relate to these models, as they confirmed our operational premises and actions

Figure A.5.24: Interaction in Learning



(Mumford, 1990 as cited in Zuber-Skerritt, 1992, p. 47)

Figure A.5.25: An Experiential Learning and Teaching Model



(Boud & Pascoe, 1978 as cited in Zuber-Skerritt, 1992, p. 48)

Faculty Development Standards
Dufour and Eaker (1998) cite the National Staff Development Council for professional development standards. The standards are organized into three categories: content, process,

and context. Content is the "what," actual knowledge or skills needed by educators. Process is the "how" of staff development or the means by which educators acquire knowledge and skills. Finally, context refers to the "organization, system, or culture" supporting the staff development initiatives (NSDC, 1995, p. 256). In addition, the Foundation for the Improvement for Education (1996) defines elements of effective professional development:

- identifies that student learning be the primary focus;
- fosters the deepening of subject matter knowledge and greater understanding about learning along with greater appreciation of students' needs;
- assists teachers to learn to work with diverse students and student capabilities, providing the time for inquiry, reflection, and mentoring;
- requires that staff development is rigorous, sustained, and results in changed practice;
- incorporates best principles and practices for adult learning;
- involves shared decision making;
- makes best use of technologies; and
- has a vision for students. (pp. 260-261)

Although focused on K-12 professional development, these standards can inform us about our own staff development, for they are appropriate regardless of the level of teaching.

The authors above agree with Sparks and Hirsh (1997) that

> in a logical progression, results-driven education for students requires results-driven staff development for educators…Staff development's success will be judged not by how many teachers and administrators [professors] participate in staff development programs or how they perceive its value, but by whether it alters instructional behavior in a way that benefits students. (p. 5)

**The above thoughts about staff development programs and whether they result in change in instructional methods, strategies, models, or behaviors express our very real concern as well. We were determined NOT to engage faculty participants in the initiative UNLESS we actually included the classroom component of the experimental research semester. There are two very real and extreme differences about our initiative: (1) the faculty development was a fully integrated "program," not a series of workshops, where faculty members actually produced real products to use in the classroom, where they made new instructional decisions, and where they completely redeveloped a course to reflect what they had learned and planned on doing with students that was new. Therefore, they did not attend a series of workshops and then go home to do the work of developing products or incorporating change. They did it WITH us while engaged in the program's activities. (2) The other major difference is that the program INCLUDED the in-classroom research semester as a program component. There were activities that continued with the professors while they were teaching that semester and implementing new strategies, using their new products, and more. Therefore, we were assured that at least for that one semester, the professors DID change their instructional practices, used new educational products, engaged in experimental research, produced research manuscripts, and changed their instructional behaviors, models, process, and strategies. We are trying to preserve that level of activity and momentum by continuing the

faculty learning community with support. That, however, cannot be fully discussed at this point. Our initiative now faces the true test:

1. Will this pilot initiative result in support for an expanded faculty learning community to engage formally together in a second round of the faculty development program?
2. Will this pilot initiative result in support for the initial and an expanded faculty learning community to engage formally together in a second round of research in the classroom – continuing the Scholarship of Teaching?
3. Will the culture begin to reflect the changes stimulated by the initial program and research?
4. Will the college learning environment begin to reflect the preferred teaching strategies, models, styles, best practices across more classrooms so that students grow accustomed and expect excellence in teaching and to be involved in research on teaching and learning?
5. Will the structure and leadership be put into place to sustain ongoing development, growth, and change by faculty and administrators?

These questions cannot be answered today. It truly is a matter of leadership.

Goleman (1995), along with many others (e.g., Cooper (1997) on Emotional Intelligence or EQ), focuses on the development of "group IQ," where a group can be no "smarter" than the sum total of the strengths of individual members, but it can be "dumber" if its internal workings do not allow members to share their talents" (p. 23). This resonates with Senge and Goetsch above; the group can be smarter than the number of individuals if an "interaction" effect is occurring, where the knowledge brought to the table by each member is unlike that of other members, not common, and if the process is transforming – that the combination of that individually different knowledge leads to or results in something greater than each part or the sum of the parts.

These authors, especially Goleman (1995), express thoughts about content for professional development of a learning community: it must be research based in content, focused on both generic and discipline-specific teaching skills, and must expand the repertoire of learning strategies to meet the needs of diverse learners. Their process is attentive to the tenets of good teaching, provides coaching to master new skills, involves reflection and dialogue, and is sustained over time. The context is clearly defined as their school - ours is the college; that the learning context is "on the job" and not arbitrarily scheduled and removed from their work place – the classroom; that time at work encourages ongoing development; and that time at work helps to develop skills. Learning is embedded in work. Action research in the classroom is consistent with their model and with what they are suggesting. We engaged in a version of that as well as formal experimental, pre-experimental, or quasi-experimental research.

Finally, an email was sent out by the Director of NIU's Faculty Development Office to the Professional and Organizational Development Network (POD) across universities internationally. He posted a request to the POD members asking them for information on faculty development, programs, courses, workshops, etc. He felt that if they had anything to

offer, there would have been responses and mentioned that the whole group is very responsive to requests from each other. There were four responses revealing that

- Colorado Community College has an online course for which completion results in various competencies for online courses: understanding when to use online discussion, being able to articulate one's philosophy, being able to write questions that illicit critical thinking, setting criteria for grading, knowing how to use small groups effectively, engaging students more effectively, etc. Although this course relates to our focus, the depth, level of engagement, requirement of products, level of intensity, and expected results are very different. Their online Teaching Practices and Techniques do reflect some of what we have tried to accomplish (http://www.ccconline.org/FacultySC/Training/Course Descriptions.htm.).

- The Centre for Professional Development at Seneca College in Toronto, Canada, offers three courses as part of its probationary program in which any faculty member, whether probationary or not, could participate. The program is also competency based to help faculty develop and/or demonstrate their competencies in teaching as well as planning and tracking. The program focus is on Foundations of Teaching and Learning; Technology-Enhanced Learning; and Language and Cultural Diversity. The expected competencies are itemized and related to what we are trying to accomplish with our faculty. It engages the faculty in 120 hours of training across the three areas of focus. Faculty members develop and submit portfolios to demonstrate previous experience, and they may also submit other learning opportunities or courses, etc. as evidence of competence. Although related to our initiative, this is also very different. One important difference is that The Centre sets up mentors for probationary faculty members, which is important for us to consider. The goals of the teaching and learning reflect many of ours, and the expected educational products are similar. However, The Centre's process seems very different. We do not have a focus on technology enhancement; however, we did have an inherent focus on culture and diversity (dominque.giguere@senecac.on.ca or www.senecac.on.ca/cpd).

- Kansas State University has an actual "Principles of College Teaching," a graduate level course that is offered both to graduate students intending to become faculty members and to faculty members. The course begins with a focus on learning and moves to strategies for teaching. The class discussions are very interactive…Class assignments and projects are individualized so that students can adapt those experiences to their current and future situations. The students develop student learning outcomes, assessment strategies, teaching strategies, and teaching philosophies. They observe video of at least one of their own teaching efforts…also contract to complete a semester project related to teaching and learning at the college level. At the end of the semester, they must share with me what they have learned form their projects (Clegg, 2005, email). (vclegg@ksu.edu) The course objectives and content relate to ours very well; however, our process and products are very different.

- The University of South Florida responded that it has a graduate level course "Seminar in College Teaching" serving students in the Ed.D. or Ph.D. programs in Higher Education and the M.A. in College Teaching Program, students in other

> programs, and recently employed full-time faculty at two community colleges. However, he mentioned that he “had not thought to advertise it to USF faculty though your [our] inquiry prompts me to once again revisit this possibility.” The goals and objectives of the course relate to ours, but once again, the process and expected products differ greatly. (jeison@tempest.coedu.usf.edu)

There are a myriad of courses, seminars, and workshops being offered on university campuses as faculty development opportunities. We all share common national speakers who are brought to campus; we also all have various locally-offered workshops, etc. However, there do not seem to be any “programs” or fully integrated courses where a faculty learning community is created and the program engages them in the content, process, performances, and product development, followed by experimental research in the classroom, as in ours. So we offer you our model, program, and process as well as the results of the classroom research. We completely reveal all evaluation and feedback as well. It is our hope that in doing so, anyone reading about our initiative will realize both its strengths and weaknesses, and for those trying similar initiatives, they can learn from ours by testing their assumptions, possibly reducing the preparation, reducing the learning curves, and/or benefiting from what we have learned and have to offer. (See Results in B.0-B.12)

For review, we have repeated the program calendar presented earlier, but have added a calendar from the perspective of October 2005 to May 2007. See calendars below.

Table A.5.20: CEET Initiative on Teaching & Learning Spring Semester Schedule (2006) (*assessment)

Thursday, Feb. 2	Thursday, Feb. 9	Thursday, Feb. 16	Thursday, March 2	Thursday, March 23
Orientation - Presentation Faculty Roles, Respons.,Duty The Scholarship of Teaching – The National Call for Action Action Research Learning Communities Knowledge Communities Communities of Practice Teaching Professionals What is Learning? What is Learning Pedagogy? Self-Assessment: The First Step in Reflective Practice Program Description & Model Student SWOTs Analysis **10/11/05–** Commitment Mtg. -Program Description -Requirements -Timeline -Expected Outcomes -Rewards *LC Assessment (a) *Self-Competency (a)	Course Analysis – Presentation Knowledge Content Outlines Knowledge Priorities Embedded General Education Goals Student Learning Objectives and Outcomes “Reversed” Instructional Design Model – Intentional Design Taxonomies of Learning Dale’s Cone of Learning Objectives & Outcomes By Bloom’s Taxonomy and Dale’s Cone *SLO Assessment (a)	Course Analysis (cont.) Objectives & Outcomes matched to assessments Assessments by Bloom and Dale Critical Thinking Teacher, Knowledge, Assessment, or Learner Centered? Test Analysis – Presentation Purpose of Test Analysis Item Analysis Item Difficulty Item Discrimination Case Test Analysis Flagged Items Analysis of Results Validity Reliability Standard Error of Measurement Using NIU’s Testing Services *Test Analysis Assessment (a)	Course Analysis (cont.) Teaching Models Teaching Styles Learning Styles Instructional Design Analysis Double Loop Learning Complete GAPS Analysis Summary Active Learning Problem-based Learning Growing up Digital Syllabus Analysis	Course Development ABET/TAC/NAIT Standards – Student Outcomes Outcomes by Bloom’s Course Calendar Introduction Syllabus Development Super Syllabus * Student Learning Objectives –Outcomes Asse–sment - SLO (a)
Thursday, March 30	**Thursday, April 6**	**Thursday, April 20**	**Thursday, April 27**	**Break April 28-May 14**
Test Devel–pment - Presentation Discrete, Objective Items Test Items/Bloom’s Taxonomy Case Test Valid Test Items Constructing Multiple C. Items Constructing Short Answer It. Develop Items-submit *Test Analysis Re-assessment (b) *Test Dev. Assessment (a)	Test Development Item Writing	Test Development Item Writing Test Development	Test Development Midterm Exam Test Assembly final Exam Test Assembly *Test Development Reassessment (b)	See you in May!

Table A.5.21: CEET Initiative on Teaching & Learning May 15-25 Schedule (*assessment)

Mon., March15-, 9am-5pm	Tues., March 16, 9am-5pm	Wed., March, 17, 9am-5pm	Thurs. March, 18 9am-5pm	Fri., Mar. 19
Regroup Day -Test Analysis, Development, Assembly Review SLO/Test Item/Bloom Analysis Continue SLO activities TEACHING PORTFOLIO Portfolio Organization THE CITL TOOL BOX Tool Box Organization Each Professor builds his/her own Tool Box *TD/A Re-assessment (c)	Performance Assessment & Rubrics - Presentation* Performance Assessment & Rubric (PAR) Development PAR #1 Share and Critique with Peers *See PA Chapter & Reference Materials *SLO Reassessment (b)	Reflective Practitioners - Presentation Development PAR #2 Share and Critique with Peers Development PAR #3 Share and Critique with Peers *See PA Chapter & Ref. Materials *PAR Assessment - Products	Balanced Assessment Course Assessment Plan PAR development - finalize Perform PAR Bloom Analysis Other Assessm. types Map Assessments (Kuhs et al.) Identify- types of assessment to include in Course A. Plan Develop descriptions, products for each type Explain Friday's Assignment	9am-5pm Teaching Models ON OWN Reading Assignment Learning Activity *TM Assessm. Product
Monday, M22 9am-5pm	Tuesday, M23 9am-5pm	Wednesday, M24 9am-5pm	Thursday, M25-9am-5pm	Summer!!
Cooperative Learning - Presentation Mapping as Assessment & Active Learning - Map Courses Complete Assessment System -Review TM/TS/CL/M Mean/Use -Review St. LS-Kolb Model -Review Dale's Cone-Analyze A. Course Content Schedule Teaching Decisions - TM, TS, St. LS Course Calendar Completion Multicultural Assignment -JS	Multiculturalism in Course Apply MC in course *Revisit Cooperative Learning Complete Assessment System Complete T/L Decisions What does your Syllabus COMMUNICATE - or NOT!! The MODEL SYLLABUS Syllabus Completion Grading Assignment-JS	Grading What Competencies do grades communicate? Plan LC Goals and Activities 12-1 Lunch with Dean Vohra Program Assessment DISC. Complete Portfolio Teaching & Learning Assign. Scholarship of Teach. Assgn. Discuss Dean/Chair Meeting *Portfolio Assessment (a) * Map Program *LC Reassessment - (b)	9-11 Classroom Research Experiments – Presentation Review Teaching & Learning Scholarship of Teaching 2:00-4:00 Dean Vohra Dept. Chairs Meeting/Profs. Program: Presentation Reflective Practice & Change Learning Community Teaching & Learning Scholarship of Teaching Set Fall LC dates 4-5pm *Program Assessment *Self-Competency Re-ass(b)	See you on: 1.Summer-Research date 2.Fall dates: a. Regroup b. MT/Final Test Analysis & Review date c. End of Semester d. Data Review e. Art. Meet.

Table A.5.22: Project Calendar – Planning, Preparation, Faculty Development, Experimentation, Documentation

October 2005

S	M	T	W	T	F	S
		11				

November 2005

S	M	T	W	T	F	S
	28	29	30			

December 2005

S	M	T	W	T	F	S
				1	2	

January 2006

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

February

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	I	N	T	R	V	25
26	27	28				

March

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
S	P.	B	R	E	A	K
19	20	21	22	23	24	25
26	27	28	29	30	31	

April

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

May

S	M	T	W	T	F	S
	1	2	3	4	5	6
F	I	N	A	L	S	G
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

June

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

July

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

August

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	M	E	E	T	S	26
27	28	29	30	31		

September

S	M	T	W	T	F	S
	P	I	L	O	T	

October

S	M	T	W	T	F	S
	P	I	L	O	T	

November

S	M	T	W	T	F	S
	P	I	L	O	T	

December

S	M	T	W	T	F	S
3P	4I	5L	6O	7T	8	9
F	I	N	A	L	15	S

January 2007

S	M	T	W	T	F	S
	1					
	8					
	15					
	22					
	29	30				

February – March 2007

S	M	T	W	T	F	S

May 2007

S	M	T	W	T	F	S
				1		
				31		

PLAN PREP

FACULTY DEVELOPMENT

Class

EXPERIMENTS

DOCUMENT

LITERATURE THAT INFORMED THE CEET SCHOLARSHIP OF TEACHING INITIATIVE
Jule Dee Scarborough, Ph.D.

Context
Bruner (1996) discusses the culture of education and reminds us that learning is not just information processing nor is it just sorting knowledge into categories. The purpose of learning is to construct meanings – not to merely manage information. He argues for consideration of one's culture and the use of narrative as an "instrument of meaning making – as narrative allows for the understanding of the past, present, and future. Learning within culture is how we construct our world, our conception of ourselves, and our powers. Human mental activity is not one that occurs solo, nor can it occur unassisted; it is not just "inside the head" (p. xi). Mental life requires, and is lived, with others. Bruner offers tenets and consequences for education:

1. The perspective tenet. First, meaning making. The meaning of any fact, proposition, or encounter is relative to the perspective or frame of reference in terms of which it is construed. (p. 13)
2. The contraints tenet. (a)The forms of meaning making accessible to human beings in any culture are constrained in two crucial ways. One first inheres in the nature of human mental functioning itself. Our evolution as a species has specialized us into certain characteristic ways of knowing, thinking, feeling, and perceiving. We cannot, even given our most imaginative efforts, construct a concept of Self that does not impute some causal influence of prior mental states on later ones. We cannot seem to accept a version of our own mental lives that denies what we thought before affects what we think now. We are obliged to experience ourselves as invariant across circumstances and continuous across time. b) In the second those constraints are imposed by the symbolic systems accessible to human minds, generally limits imposed by the very nature of language and, more particularly, constraints imposed by the different languages and notational systems accessible to different cultures (the Whorf-Sapir hypothesis) that thought is shaped by the language in which it is formulated and/or expressed. (pp. 15-18)
3. The constructivism tenet. (implied above) The "reality" that we impute to the "worlds" we inhabit is a constructed one – "reality is made, not found"(Goodman, 1992). Reality construction is the product of meaning making shaped by a culture's toolkit of ways of thought. Education must be conceived as aiding humans in learning to use the tools of meaning making and reality construction to better adapt to the world in which they find themselves and to the process of changing it as required. (Bruner, 1996, p. 19)
4. The interactional tenet. Passing on knowledge and skill, like any human exchange, involves a subcommunity in interaction. (p. 20)
5. The externalization tenet. Collective cultural activity is to produce works…[these works] help make a community and communities of mutual learners. Works and works–in-progress create shared and negotiable ways of thinking in a group. Externalizing mental work…produces a "record" of

mental efforts, one that is “outside us” rather than vaguely “in memory” [and] …relieves us from…“thinking about our own thoughts” while accomplishing the same end – embodies our thoughts and intentions in a form more accessible to reflective efforts…the process of thought and its product become interwoven. (p. 22)

6. <u>The instrumentalism tenet.</u> Education, conducted in whatever culture, always has consequences in the later lives of those who undergo it…[and] provides skills, ways of thinking, feeling, and speaking that later may be traded for “distinctions” in the institutionalized “markets” of a society….Then, education is never neutral, never without social and economic consequences….Education is always political in the broader sense. (p. 25)
7. <u>The institutional tenet</u>. As education in the developed world becomes institutionalized, it behaves as institutions do, and often must, and suffers certain problems common to all institutions. Cultures are composed of institutions that specify more concretely what roles people play and what status and respect they are accorded. Institutions do the cultures’ serious business. [They] provide the “markets” where people “trade” their acquired skills, knowledge, and ways of constructing meanings for “distinctions” or privileges. (pp. 29-30)
8. <u>The tenet of identify and self-esteem.</u> Perhaps the single most universal thing about human experience is the phenomenon of “Self,” and we know that education is crucial to its formation. Education should be conducted with that fact in mind. (p. 35)
9. <u>The narrative tenet.</u> The mode of thinking and feeling that helps…people create a version of the world in which, psychologically, they can envisage a place for themselves – a personal world….Story making, narrative, is what is needed for that. (p. 39)

Bruner (1996) emphasizes the powers of consciousness, reflection, breadth of dialogue, and negotiation in his tenets. They pose risks because they seek to open discussion of the current institutional authority. He mentions that the tenets and education are both risky as they “fuel the sense of possibility” (p. 42). He feels that a failure to equip minds with the skills to understand, feel, and take action in their culture is not just pedagogically zero, but creates alienation, defiance, and incompetence that in turn undermine a culture. Education is not just a technical business of managing information processing or learning theories and then assessing their achievement. It is very complex where members of a group fit to achieve the needs of that culture (p. 43). This requires authentic teaching and learning. Palmer (1993) speaks of authenticity as the creation of the community of truth: “to teach is to create a space in which obedience to truth is practiced” (p. xvi). Obedience is removed from its authoritarian connotation. This requires knowing the nature of reality where community, not competition, is the metaphor from science. Palmer mentions that students learn as much from the “hidden curriculum” – institutional patterns and practices – as they do from the formal curriculum. He advocates that the image of reality is less individualistic and competitive and more cooperative and communal because learning is a communal act where knowing goes beyond relations of knowers to a community of interaction between knowers and the known, where there is a myth of objectivity, where

the “true work of the mind is to reconnect us with that which would otherwise be out of reach” (p. xvi). He says that some students resist thinking because they live in a world of fragile relationships; that these students are desperate for more community and, because of that, when thinking is presented to them as a way of disconnecting themselves from each other and the world (an objective approach), they do not want to engage. He feels they want to “create community, a way of knowing (engage in a community of learning)” (p. xvii). This certainly informs our initiative.

The seminal work by Boyer (1990) led the Carnegie Foundation to engage in the Ernest L. Boyer Project of the Carnegie Foundation for the Advancement of Teaching.[1] Boyer raised the issue of how faculty spend their time and what they are rewarded for doing. This led to the question: "what activities of the professoriate are most highly prized… [noting] that it is futile to talk about improving the quality of teaching if, in the end, faculties are not given recognition for the time they spend with students?" (p. xi). He traces the debate throughout history, illuminating the transitions and shifting priorities of American higher education, noting that students are often the losers and further noting that students

> are assured that teaching is important, that a spirit of community pervades the campus, and that general education is the core of the undergraduate experience….but the reality is that, on far too many campuses, teaching is not well rewarded, and faculty who spend too much time [working with students] may diminish their prospects for tenure and promotion. (p. xii)

Boyer’s (1990) goal in this work is to "break out of the tired old debate and define, in more creative ways, what it means to be a scholar…recognize the full range of faculty talent and the great diversity of functions higher education must perform... [stating that] for American higher education to remain vital, we urgently need a more creative view of the work of the professoriate" (p. xii). Most important in his introduction is his acknowledgement of the "need [for] a climate in which colleges and universities are less imitative, taking pride in their uniqueness…to end the suffocating practice in which [they] measure themselves…by external status rather than by values determined by their own distinctive mission" (p. xiii). He frames the question of better education in the context of how scholarship is defined and rewarded, trying to reflect what he and others consider the full range of academic and civic mandates, and describes four views of scholarship - "discovery, integration, application, and teaching," defining them as follows (pp. xii-xiii).

(1) Knowledge for knowledge sake - the creation of a bank of knowledge or information, ready to draw upon when the time for intelligence use arrives (Thomas, 1977 as cited in Boyer, 1990).

> <u>Scholarship of Discovery</u> comes closest to what academics [identify] as research…the freedom of inquiry and to follow, in a disciplined fashion, an investigation wherever it may lead….Not just the outcomes, but the process, and especially the passion, give meaning to the effort.

[1] This information is also replicated in the introduction.

[Boyer quotes] Bowen (1986), "scholarly research reflects our pressing, irrepressible need as human beings to confront the unknown and to seek understanding for its own sake…tied inextricably to the freedom to think freshly, to see propositions of every kind in the ever changing light. And it celebrates the special exhilaration that comes from a new idea (p. 17).…[T]he probing mind of the research is an incalculably vital asset to the academy and the world…the very heart of academic life…the pursuit of knowledge must be assiduously cultivated and defended…the discovery of new knowledge is absolutely critical. (pp. 117-118)

(2) Authenticating knowledge through analysis and interpretation, establishing meaning or original research through interdisciplinary consideration and synthesis.

<u>Scholarship of Integration</u> - the need for scholars who give meaning to isolated facts, putting them in perspective…making connections across the disciplines… serious, disciplined work that seeks to interpret, draw together, and bring new insight to bear on original research.

[Boyer quotes] Van Doren, "[t]he connectedness of things is what the educator contemplates to the limit of his [her] capacity." It is through connectedness that research ultimately is made authentic…closely related to discovery…where fields converge…[where one fits] one's own research – or the research of others – into larger intellectual patterns….Those engaged in discovery ask "What is to be known, what is yet to be found?" Those engaged in integration ask, "What do the findings *mean*? and provide a …more comprehensive understanding…requiring critical analysis and interpretation." (pp. 18-21)

(3) Where scholarship connects theory and practice and proves its worth to the nation and world.

<u>Scholarship of Application</u> - How can the knowledge be responsibly applied to consequential problems? How can it be helpful to individuals as well as institutions? Can social problems themselves define an agenda, serving the interests of the larger community.

[When considering the following international perspective by Harper (1906)] … Scholarship…was regarded by the British as "a means and measure of self-development," by the Germans as "an end in itself, "but by Americans as equipment for service." Self-serving though it [the American perspective] may have been, this analysis had more than a grain of truth…the gap between the academy and the needs of the larger world…service is routinely praised, but accorded little attention.

Colleges and universities have rejected service as serious scholarship, partly because its meaning is so vague and often disconnected from serious intellectual work…[e.g. projects, committees, etc.]. Clearly, a distinction must be drawn between citizenship activities and projects that relate to scholarship itself….To be considered scholarship, service activities must be tied directly to one's

professional activity…serious, demanding work, requiring rigor…[and] accountability…associated with research activities…The process we have in mind is more dynamic [where] new intellectual understandings arise out of the very act of application, [where] theory and practice vitally interact, and one renews the other… both apply[ing] and contribut[ing] to human knowledge…[using] the skills and insights only the academy can provide…

Handlin observed our troubled planet "can no longer afford the luxury of pursuits confined to an ivory tower"…[where] scholarship has to prove its worth not on its own terms but by service to the nation and the world. (as cited in Boyer, pp. 21-23

<u>Scholarship of Teaching</u> - [where] the work of the professor becomes consequential….as it is understood by others…Today teaching is often viewed as a function…[; however,] Aristotle said, "Teaching is the highest form of understanding."....beginning with what the teacher knows…steeped in the knowledge of their fields….One reason why legislators fail to understand why 10-12 hours in the classroom each week can be a heavy load is their lack of awareness of the hard work and serious study that undergirds good teaching,…a dynamic endeavor involving all analogies, metaphors, and images that build bridges between the teacher's understanding and the student's learning. Pedagogical [and adrogogical] procedures must be carefully planned and continuously examined…[According to] Palmer (1983)…knowing and learning are communal acts. With this vision, great teachers create a common ground of intellectual commitment. They stimulate active, not passive, learning and encourage students to be critical, creative thinkers, with the capacity to go on learning after their college days are over. Further, good teaching means that faculty, as scholars, are also learners….[not] transmit[ting] information that students are expected to memorize and then recall…but *transforming* and *extending* it as well…Inspired teaching keeps the flame of scholarship alive…All academics credit good teachers…defining their work so compellingly that it became…a lifetime challenge. Without the teaching function, the continuity of knowledge will be broken and the store of human knowledge dangerously diminished.

Oppenheimer (1954) noted…"The specialization of science is an inevitable accompaniment of progress; yet it is full of dangers, and it is cruelly waster, since so much that is beautiful and enlightening is cut off from the rest of the world. Thus, it is proper to the role of the scientist that he [she] not merely find the truth and communicate it to his [her] fellows, but that he[she] teach, that he [she] try to bring the most honest and most intelligible account of new knowledge to all who will try to learn…knowledge is acquired through research, synthesis, practice, and through teaching. (as cited in Boyer, 1990, pp. 23-24)

These four types of scholarship acknowledge the great range of talent and diversity within the professoriate. The creative tension between the above definitions stimulates us to appreciate scholarship from a broader perspective, each type contributing significantly

to the other and ultimately to the development of humanity and its endeavors through the academy and other contributing institutions.

Also important to us is Boyer's (1990) point that there is a unique opportunity for comprehensive universities, one where we can establish our own unique missions rather than imitate the traditional research universities, the opportunity to blend quality with innovation, choosing the foci of our passion (whether Scholarship of Discovery, Scholarship of Integration, Scholarship of Application, or the Scholarship of Teaching) with the understanding that the Scholarship of Teaching is a requirement for knowledge to continue to expand and be used. We agree with Boyer that "diversity with dignity" (p. 64) is building a diverse learning system and learning organization where undergraduate and graduate learning are priorities; where the Scholarship of Teaching is honored and prioritized in conjunction with other types of scholarship; where they integrate, one not dominating the other; and where the diverse range is sought, sustained, and respected. Thus, not only is it mandatory that we move ahead to formally acknowledge the importance of the Scholarship of Teaching alongside the others, it also reaffirms and acknowledges the importance of the historical commitment to teaching and student learning in our service to secondary education and extends that work into our own engineering and technology classrooms at the university level in an informed manner, with an understanding of what our vision means, what will be required to attain it, and that the extension of knowledge rewards what will ensue. This vision attends to preparing students for their professions as learning individuals, integrating general and major education more relevantly and overtly, strengthening capstone experiences, and ultimately examining the master's degree educational experiences to determine what needs to be sustained or strengthened. Most important is to establish a more productive relationship between teaching and student learning. Therefore, we engage in this initiative to actively explore that relationship through teaching and learning research. We will begin simply with a two-pronged, but interdependent, research initiative: the first research focus will be the design, development, and piloting of a new faculty development model and program to prepare a pilot group of faculty to actively engage in experimental research on classroom teaching and student learning; the second research focus will be the actual experimental classroom research on teaching and student learning (TL). Both of these activities will be rigorously evaluated to determine their value to inform the faculty and administration about what the next level of activities should be to sustain, expand, and deepen the Scholarship of Teaching initiative. As Boyer (1990) establishes, we have the opportunity to determine our own unique model and what is acceptable as faculty role, function, and responsibility.

Glassick, Huber, and Maeroff (1997) expanded Boyer's (1990) conceptual standards for faculty research by engaging in a project to assess scholarship by the professoriate. One of the top priorities of the Carnegie Foundation was to strengthen undergraduate education. Boyer and his colleagues tried to clarify the purposes of higher education, explore what constitutes quality, and examine its functions. Teaching became less well rewarded after World War II, and service changed from a tradition of extending knowledge beyond the campus to a variety of less important activities. Sharing

knowledge through teaching is no longer prestigious and research has become the priority.

Clark (1987) questioned why research became the only form of scholarship considered worthy when “the greatest paradox of academic work in modern America is that most professors teach most of the time, and large proportions of them teach all the time, but teaching is not the activity most rewarded by the academic profession nor most valued by the system at large” (pp. 98-99). Those at the Carnegie Foundation submit that the skewing of the mission of higher education toward research has created a kind “crises of purpose” in American universities, leading to other functions (e.g., teaching) becoming undervalued and resulting in high costs to undergraduate education. Boyer and Levine (1981) argued that the gap between rhetoric and the reality of curriculum must be closed and that connections to and understanding the world must again become a priority. Another aspect of the academy has suffered – that of the application of knowledge through professional service from too narrow a definition of research. Boyer's (1990) goal was to move beyond this research versus teaching debate and provide a more efficacious meaning for research and to identify the work of faculty in ways that enrich the quality of undergraduate education, where there is “an educationally purposeful community, a place where faculty and students share academic goals and work together to strengthen teaching and learning” (p. 12). Glassick et al. (1997) continue Boyer's line of thought but move beyond the conceptual to the development of criteria and procedures for each type of research through extensive research of the literature, handbooks, policy statements, faculty consultations, conferences, survey research, and more while collecting data from all four-year colleges and universities and 600 on faculty evaluation. Glassick et al. establish that all four types of research must be held to the same standards of scholarly quality performance rather than accepting the current practice that different types of standards apply to different types of faculty work. There is an emerging climate to support the idea of the different types of scholarly work. Faculty members are accumulating evidence of achievements across the four types of research. What then are the common dimensions of scholarly work? The authors' research clearly showed that when a work of scholarship is appreciated, faculty agree that it has been guided by clear goals and adequate preparation, has engaged appropriate methodology, has accomplished significant results, was presented effectively, and involved reflective critique. Glassick et al. go further to describe each of these qualitative standards:

- <u>Clear Goals</u> - Does the scholar state the basic purposes of his or her work clearly? Does the scholar define objectives that are realistic and achievable? Does the scholar identify important questions in the field?
- <u>Adequate Preparation</u> - Does the scholar show an understanding of the existing scholarship in the field? Does the scholar bring the necessary skills to his or her work? Does the scholar bring together the resources necessary to move the project forward?
- <u>Appropriate Methods</u> - Does the scholar use methods appropriate to the goals? Does the scholar effectively apply the methods selected? Does the scholar modify procedures in response to changing circumstances?

- Significant Results - Does the scholar achieve the goals? Does the scholar's work add consequentially to the field? Does the scholar's work open additional areas for further exploration?
- Effective Presentation - Does the scholar use a suitable style and effective organization to present his or her work? Does the scholar use appropriate forums for communicating work to its intended audiences? Does the scholar present his/her message with clarity and integrity?
- Reflective Critique - Does the scholar critically evaluate his or her own work? Does the scholar bring an appropriate breadth of evidence to his or her critique? Does the scholar use evaluation to improve the quality of future work? (pp. 22-36)

This, then, becomes the common language with which to discuss standards for scholarly work - all types of scholarly work. This language helps establish what the four types of research (discovery, integration, application, and teaching) share as scholarly activities.

Providing evidence of quality or documenting scholarship so the evidence directly shows the standards have been met requires a wide variety of materials. Some thoughtful educators feel that well prepared documentation promotes better scholarship because it engages them in the justification of their achievements. This, in turn, promotes more reflective practice that leads to improvements. Once again, this must equally apply to all types of research. A challenge may be that an expanded definition of research leads to concerns about the types and sources of documentation necessary to provide evidence of quality research. However, for example, discovery or traditional research is more easily documented with peer review processes, publication criteria, etc. already in place. Discovery research results are more easily documented. The process of teaching may not be as easily documented (e.g., working with students in an office, preparation for teaching, the follow-through process, elements not in print or easily objectively documented). Social science research (research involving human interaction, institutional constraints, dynamic organization, etc.) is not as easily implemented as a laboratory experiment in the sciences, engineering, or technology. In fact, one of the greatest difficulties educational researchers have is where colleagues not engaged in educational research do not understand the context of the research, and even more impacting is that educational research may require more time and different designs and methodology. Furthermore those from the sciences and engineering remain suspicious when confronted with the more qualitative aspects of the research and methodologies. Therefore, acceptable documentation must include a more "eclectic" array of sources and types. This is the only way the newer forms of scholarship can be treated fairly (e.g., integration, application, and teaching). Regarding teaching, there has long been agreement that documentation can be more creative – for example, a variety of portfolios. Portfolios are a good example of appropriate documentation on the scholarship of teaching and, when designed as assessment and evaluation documentation and include a process of integrity, can easily reveal the results of implemented changes – what has been learned. Therefore, there needs to be in-depth consideration of what types of information or research evidence will provide clear documentation of the research results. In addition, there must be a climate of trust between the faculty and administration, with clear understanding

about the expectations of performance. This will go far to continue to recognize that professors “have special responsibilities to their disciplines, their students, their colleagues, and their institutions”: integrity, professional ethics, perseverance, and courage (Glassick et al., 1997, p. 61).

There is a dearth of authors who, throughout the nineties and now, continue to discuss the roles of higher education faculty, their academic work, and the rewards for their work. The stimulus for much of that discussion is about faculty teaching, whether teaching in higher education is a real priority and how the reward structure seems to reflect it as a lesser priority when a faculty member is considering promotion, tenure, prestige, and "power" within the academy (Gallos as cited in Frost & Taylor, 1996). Whicker et al. (1993 as cited in Frost & Taylor) describe the "publish-or-perish" situation at major universities, where less than adequate teaching may cause difficulty in being awarded tenure; however, an outstanding publishing, research, or grants record may compensate for weak or mediocre teaching. Conversely, excellent teaching is not often sufficient to compensate for inadequate publishing, research, or grant awards. Although most universities have the criterion of adequate teaching along side research and scholarship and service, the latter is much more significantly weighted. Meeting the research criterion also involves getting grants that are expected to produce results that end up published by acceptable sources. Greater grant awardees are more tenurable than those who have fewer, and worse yet, faculty members may be awarded tenure or promotion based upon a high record of grant awards with no publication record to validate results or outcomes. Having brought that issue to the discussion, it might be important to give caution. Grants are awarded by agencies or organizations that may prohibit publication; or grant participants (e.g., schools) may not be willing to engage if the results are to be published. Even though public, (e.g., state or federal grants) are awarded openly and have no restrictions about publication, there are times when grants produce important results that cannot be published. The reward system needs to work for faculty members who may be caught in those situations or those who are doing highly sensitive research with private parties for which proprietary information cannot be published by the professor(s). Colleges and departments need to carefully address these situations and figure out how to accommodate "grants" or "contracts" for which it may not be possible to validate their results and outcomes through publication. Braxton (1996) leads a rich discussion through nine chapters by various authors on the relationship between teaching and research. In this volume, Braxton discusses the conflict between research and teaching and brings forth Boyer's (1990) comments that to accommodate research activities by professors, their teaching loads are reduced, teaching assistants are assigned to large undergraduate courses, and thus undergraduate needs are ignored. Braxton brings to bear the public expectation that faculty members spend more of their time and efforts on teaching than scholarship activities and discusses the conflict or competition between the two faculty functions from contrasting perspectives: null, conflict, and complementarity (p. 6).

- <u>Null</u> - This perspective posits that there is no relationship between teaching and research; the roles are independent of one another (Finkelstein, 1984) and do not detract from one another (Linsky & Straus, 1975). Thus, the null relationship may be the inverse of complementarity. More specifically, teaching and research may be clearly set apart from general ability, professional goals, and values. Also

there may be a lack of correspondence between teaching and research specializations. Moreover, these two roles may not be mutually reinforcing.

- Conflict - There are several variations of the position that a negative relationship exists between teaching and research. One is that the roles of teaching and research conflict because they carry different expectations and different obligations (Fox, 1992). Another variation is the assertion that the allocation of time sums to zero. Because productive scholars spend more time in research, they spend less time in teaching. Consequently, the quality of teaching is adversely affected by the lesser amount of time spent in teaching activities (Finkelstein, 1984). A third variant is that teaching and research require different abilities and personality traits. (Finkelstsein, 1984; Linsky & Straus, 1975)

- Complementarity - refers to the extent to which the roles of teaching and research are similar on several dimensions (Faia, 1976). *General ability* is one such dimension. Teaching and research require the same general ability in the enactment of these two roles (Finkelstein, 1984; Linsky & Straus, 1975). Because the academic profession's basic goal of "furthering knowledge" can be realized through both research and teaching, professional goals represent another dimension on which similarity may exist (Faia, 1976). *Values* are another point of possible similarity (Fox, 1992; Parsons & Platt, 1973; Shils, 1983). Holding cognitive rationality as a value, for example, suggests favoring an integration of the roles of teaching and research (Parsons & Platt, 1968). Cognitive rationality is the comprehension and solution of intellectual problems in rational terms (Platt, Parsons, & Kirshtein, 1976); this value pattern manifests itself in both teaching and research (Braxton, 1983).

Although not a lot, there is some research to support the relationship between teaching and research. Feldman's (1987) meta-analysis is the most comprehensive and most recent. He found, after reviewing 29 studies, that there was an average correlation of +.12 ($p<.001$) between research productivity and student assessments of teaching effectiveness, thus some support for complementarity between research and teaching. Braxton (1997) added the Voeks (1962) study and also addressed the question of the extent of support for the three types of perspectives. He found that both the complementarity (11) and null (18) perspectives receive moderate support. However, the conflict perspective (1) received weak support. When Feldman executed his analysis, he classified each institution by Carnegie classification; the null perspective receives strong affirmation in research universities. The null and complementarity perspectives have modest support in the remaining four classifications: doctoral, comprehensive, liberal arts, and unspecified. He concluded that "research does not interfere with teaching effectiveness," and "a systematic relationship between teaching and research role performance does not exist across different types of colleges and universities" (p. 8). This raises yet more questions about the state of affairs between these two roles or functions. Is the null situation a natural condition? If complementarity exists, do individual faculty characteristics or culture contribute to it? Do faculty's professional goals and values make the difference? If faculty members have a dual orientation toward both roles,

complementarity may then exist, or could differences occur across organizational cultures, especially if the two roles are equally valued. Sullivan goes further to consider teaching norms and publication productivity, finding that there is no significant difference in teaching support and publication productivity and “the mechanisms of social control for teaching are not attenuated by high levels of publication productivity….Apparently faculty members recognize and acknowledge norms that support teaching, while simultaneously participating in the research activities expected in today's academic environment” (as cited in Braxton, 1996, p. 19). This indicates a more positive view to an ongoing discussion that often seems to have a negative tone.

The authors of this volume go on to discuss teaching norms and publication productivity; research activity and the support of undergraduate education; the research versus teaching debate; untangling the relationships; faculty productivity and the complexity of student exam questions; triangulating the relationships among publication productivity, teaching effectiveness and student achievement; institutional and departmental cultures: the relationship between teaching and research; and framing the public policy debate on faculty: what is the role of research? This volume ends with a piece on public trust, research activity, and the idea of service to students as clients of teaching. Olsen and Simmons (as cited in Braxton, 1996) mention Feldman's (1987) results as disappointing and note that public concern over the rising costs and quality of undergraduate education was rising, especially when considering the impact of research and its supporting reward system on instruction (Fairweather, 1993; Winston, 1994). Goode (1960) and Merton (1957) introduce "role conflict" as a theory in which proportionately less time and energy is spent on one role as more is invested in another. Thus, faculty members who teach where research is more valued and rewarded spend less time and energy on teaching.

Diamond and Adam (1993), Fairweather (1993), Fairweather and Rhodes (1995), and Moore and Amey (1993) agree that faculty reward systems, salary assignments, and prestige constraints undermine professional investment in teaching. Massey and Wilger (1995) go further to point out that even where the quality of teaching is relatively high, more time and effort would still improve the quality of undergraduate education. Other issues abound. Faculty interested in research may be less interested in undergraduate curriculum if perceived as less intellectually stimulating and thus not as tuned in to students' needs. Finally, research often requires isolated and focused time and solitude, which does not lend itself to making time for students (Faia, 1976; Fairweather, 1993; Feldman, 1987; Friedrich & Michalak, 1983). Conversely, some theories endorse the complementarity perspective as one in which there are synergies between the research and teaching roles or functions and that those roles are mutually supportive. For example, active researchers more often keep their courses infused with current developments or information, hold their students to higher standards, communicate their enthusiasm, and seem to have a better sense of knowledge growing over time (Centra, 1983; Sieber, 1974; Thoits, 1987). They, again, mention the Feldman study (1987), as he identified four instructional dimensions to be most strongly associated with research productivity: knowledge of subject matter; intellectual expansiveness; preparation and organization of course; and, clarity of course objectives and requirements. However, they also mention

that Feldman's study indicated that not all aspects of teaching and research are closely aligned (e.g., student rapport and research productivity).

Volkwein and Carbone (1994) studied a different issue of department culture and reward system orientation. They found that when departments valued both research and teaching, there were positive academic outcomes for students, but when considering the relationship between research productivity and instructional methodology by faculty members, the research is vague. Once again, Feldman (1987) posited that pedagogical skills may be enhanced by research productivity (e.g., knowledge, organization, intellectual expansiveness, and clarity). Olson and Simmons's (as cited in Braxton, 1996) study measured research productivity over a multi-year timeframe, employing institutional data used to make salary and other decisions. The study also considers actual data about actual classroom practices, which goes beyond the other studies assessing teaching effectiveness using summative student evaluations. Finally, also different, Olson and Simmons executed their study in a large research institution. They found that faculty spent 44% of their time on teaching and 34% on research, figures close to those reported nationally by Research I institutions at which 43% is spent on teaching and 29% on teaching (National Center for Educational Statistics, 1990). These authors present that their data indicated a significant negative relationship between the amount of time spent on research and teaching and conclude that their results failed to support the current view that many positive teaching behaviors are inversely related to research productivity, that faculty research faculty did not avoid teaching lower-level undergraduate classes, that faculty did not rely more on lecture and less on active learning techniques, and that research faculty did not use more multiple-choice tests in their courses than other faculty members. However, Olson and Simmons did not provide significant evidence that more productive researchers demonstrate higher levels of pedagogical skills and that faculty with higher research productivity did seem to spend less contact time with students. They sum it up by suggesting that research and teaching performance are unrelated when teaching is defined by instructional practices and are negatively related when some aspects of student-faculty contact are considered. They recommend that contact time between faculty and students benefits both, that active learning techniques should be encouraged, that the teaching evaluation process needs to be broadened, and that undergraduates should be provided the opportunity to learn first hand about faculty research, linking teaching and research. Also in Braxton (1996), Johnson’s results considering faculty productivity and the complexity of student exam questions revealed that “scholars who publish books and those who publish fewer articles ask more critical-thinking questions and that publishing more articles seemed to negatively affect the asking of such questions” on student exams (p. 41).

André and Frost (1996) offer many interesting and thoughtful discussions throughout the individual chapters from perspectives of "researchers hooked on teaching." For example, Fukami begins by seeing both research and teaching as requiring curiosity and humility (the ability to recognize that you do not know everything) and confidence in what you think, as well as the ability to break complexities into more manageable pieces and to identify new issues and intrinsic motivation. Teaching and research "are merely two actions we take in playing out one role: a faculty member who creates and disseminates

knowledge" (as cited in André & Frost, 1996, p. 5). Also important, Fukami notes teaching and research can represent two different roles and real differences:

1. "Teaching is immediate and research long-run," where teaching immediately reveals whether students are learning (if there is adequate and timely student assessment in place) and research is concluded and presented to the community at large over a great deal of time, often years between the beginning of a research project and results dissemination.
2. "Teaching is forgiving, whereas research is cruel," where mistakes in teaching can be rectified, but the research and publishing or disseminating process is difficult, often a highly anxious and long or short window process.
3. I feel confident that my teaching makes a very real impact, whereas research (at least in the way we currently perform it) may never affect anything real. (pp. 4-5)

Fukami concludes with lessons learned, mentioning that balance is important but may not be calm, that one may be committed to more than one object or identify with one organizational membership (as cited in André & Frost, 1996). She (with others) conducted a study on unionized workers and whether they could be loyal to both the company and union and found that, in fact, performance was higher and absenteeism lower for workers committed to both company and union over workers committed to only one. The results were similar with nurses when considering commitment to the profession, hospital, or coworkers. These studies may have implications for higher education: faculty members can have multiple and concurrent commitments. Certainly, we have at least one example of that.

Gutek, another author in André and Frost (1996), believes that teaching and research are

> inexorably linked…view[ing] it as primarily a way to explain research to others…[that] research findings would never be disseminated to the public through journals, nor were they ever intended to do that. They are too dull, boring, tedious, and difficult to understand for anyone not trained in research….Teaching [presents] real possibilities as a way to inform young minds about the progress being made on the research front….[However], my views about the role and purpose for teaching have changed….I now worry that the wonderful interplay of teaching and research is being threatened by changes in higher education. (p. 27)

It is important to understand how Gutek began teaching, as it is the opinion of this author (Scarborough) that it is one of the very best methods and one that she has used throughout the teaching aspect of her career. Gutek (and Scarborough) immerse themselves in the literature to identify course content, as they both feel there is never a textbook or "package" that agrees with their idea of the content or materials needed. (Scarborough has included texts as requirements; she does not use them as *the* content but rather as one validation source of content chosen.) So the review and summarization of the literature is one of their methods of identifying the research, theories, and information they wish to cover.

At one point Gutek did not believe in case studies as a student research activity and a method to validate the conceptual or theoretical content; however, in moving from a

psychology department to a business management department, Gutek realized that concepts and theories are not enough to explain theory and concepts. One might describe it in this way: the conceptual and theoretical are one thread and the real world cases are another, but both threads are required to weave the whole fabric of understanding. This is in line with Scarborough's long practice of weaving the theory with practice and practice in the field or "communities of practice." Cases present opportunities to analyze what is going on and actually provide a context within which to analyze theories, concepts, principles, or information taught. Gutek feels that professors need to cover content they really know themselves, not just that from others' textbooks, and to present as many perspectives as possible. We both agree that it is important to critically analyze content, regardless of the position on content.

Gutek, however, has undergone a theoretical change about teaching – professor as expert (content more important than process). That model is heavily criticized today, especially since students come to us with a different perspective. In Gutek's case, and mine as well, most of our students are working part to full time while engaged in courses or degree programs for a variety of reasons. A change in student focus makes us reconsider what we teach and how we teach it as well. She mentions that when moving from psychology to the business college, her students were more focused on getting a job and what the employers expected them to learn - education is an investment in their future and that knowledge of research may or may not be always important. This is very true with our engineering and technology students as well. In my opinion, this makes it difficult to teach irrelevant content without validation and connection to the world external to each course or the world within which course content can be contextualized. This scenario changes the role of the student and the perspective towards education.

Another issue has risen in my context, one where when students are working and cannot seem to make the demands of the course activities work with their employers' demands and schedules. These students feel the professor should change the course requirements so they are easier to accomplish. At least once a semester I have this discussion with my department chair. He and I always end up agreeing that we cannot reduce the integrity of the course or its required activities. This does not mean that we do not care. We do work very hard to understand our students' lives and contexts and we do accommodate them wherever we can, but course content, good teaching models and methods, and those real-world connections have an integrity base of their own – those we do not sacrifice. Therefore, Gutek provided a great opportunity to consider her transitions with those of this initiative.

Good teachers have these discussions all the time and are always rethinking their values, requirements, strategies, and content. It is exciting to do so, and each semester brings a new and different context to the table. This brings the perspective of our public into the conversation more directly, as we are impacted by what employers want. One method to include a public entity is through course content validation, in our case through business and industry or our students' employers.

Approximately every two to three years or so, I send my course syllabi, with additional information, out to members of the communities of practice related to our field and courses. They validate the content, and often we also discuss the teaching methodologies apparent in the requirements. This is an additional way of seeking course content than those mentioned above. The process provides great feedback, input on what might need to be added, and can be a way of prioritizing or weighting the significance of content. When considering the public, new questions become part of the equation: "Who is our customer?" and "What is our product?"

Those of us immersed in the scholarship of teaching debate - whether naturally, or intentionally - have always seen research and teaching as equal, connected, and stimulating roles or functions within the professoriate. We are always changing, at least partially driven by student needs and expectations. The educational and learning context for students is complex at best. In their context, program requirements, scheduling conflicts, educational costs, working while enrolled, and family responsibility can overwhelm them. This has changed student focus, so often they are not really interested in faculty expertise content. Gutek (as cited in André & Frost, 1996) mentions that "students have come to expect a uniform product from each faculty member teaching a class, and they seem to have little knowledge about or interest in special areas of expertise of the faculty" (p. 35). Although I agree with this, I have found that my students are interested in learning just about anything I want them to learn about. However, I must admit that interest is impacted positively by the ways they are required to learn about it. One must risk student criticism and the possibility of a negative impact on course evaluations.

For those professors who are themselves inquisitive and open (who are learners and seekers), a natural learning community develops in their course environments, microcosms where faculty and students learn from each other as well as from the course content through a variety of methods and processes. Gutek and I have a lot in common, and both of us have learned through this process that *research* is not the only content response for course content but is important as one source of content. When Gutek moved from psychology to business, she become more aware that there is a great mixture of content important for courses, especially linking theoretical and conceptual to its relevance within real "communities of practice" and that how it is taught truly and greatly impacts what is learned. Finally, the external communities of practice are creating new theory and concepts that have yet to reach the research base or textbook content.

She also describes that impact on higher education in her encounter theory, where the relationship between provider and a recipient of goods is changing to *encounters*. She goes on to describe "that higher education systems are increasingly moving in the direction of encounter systems to save costs and to compete to provide education services. Encounter systems offer uniform products, which leads to the point that

> undergraduate students view faculty as interchangeable providers of service rather than as unique repositories of knowledge and ability to the extent that they evaluate delivery process as more important than content of material covered. Higher education is expected to resemble mass production of services

> characteristic of encounter systems where products or processes are uniform. (p. 38)

I agree that this is bad news for both faculty and students; for example, general education courses with high numbers of students begin to resemble encounter systems: mass production with predictable content and processes regardless of who provides them. All said and done, Gutek still feels that teaching and research are interdependent rather than independent ventures, roles, or functions, and I agree. However, we must realize that universities are not the only primary producers of research and even the university work is sometimes not published as quickly as it should be. Thus in my opinion, any access to research only provides a deeper and broader base for student learning. We have branched off into research as content of coursework, but our consideration of research here is multifaceted: research as course content, the relationship between research and teaching, and further to faculty endeavors to engage in research on teaching and learning alongside their disciplinary research.

André, also in André and Frost (1996), contends

> that academics do not do teaching and research…at least [hopefully] not. These are superficial conceptualizations of our professional selves, of our thoughts and ideas and skills. No, what we do is deeper and more complex: we search for truth, we push for intellectual innovation, we share our truths and innovations with particular audiences, and we create environments that enhance learning. This is much more exciting and more involving and more relevant than mere teaching and research….Of course the words teaching and research do convey a rough sense of our primary audiences (we teach our students, we research for our peers). Second, the words are a convenient shorthand for our behavior…what we do on a daily basis is stand up before audiences and profess (we teach), and then we spend quiet time discovering, organizing, and committing our ideas to print (we do research). Third, we believe that success in teaching and research is measurable. (p. 41)

André discusses the *tired* issues within the debate but also brings a different perspective. She describes the dichotomy of research-teaching as one that minimizes what professors do when considering complexity, ideals, and impact, making the point that it is mere categorization. This, she suggests, is caused by our failure to communicate the complexities of what we actually do to the external world. She takes the debate to a different plane:

> Words connote an unfortunate status bias, with teachers and teaching being ranked below researchers and writing. Culturally, the upper class thinks, reads, and writes, but does not teach, as that may be below their station; they produce intellectual [original or extensions] works. Among those classes, leisure is more desirable than work or scheduled activity-work, e.g. scheduled by an institution. Therefore, in our context, research is self-scheduled, versus teaching scheduled by others. Research is creating with freedom and individuality in tact, whereas teaching may be perceived presenting “someone else's ideas” suggests servitude and conformity. (p. 41)

André presents thoughts that this dichotomy reveals who we become and how we succeed in the profession and that the commonality between the two, teaching and research, is "striving for truth and innovation in our field(s)…addressing different audiences through different modes" (p. 42).

André defines truth and innovation. As scholars, truth may be exemplified in the research methodology we choose or a personal predilection of reality. She mentions that one way academics see truth is through a peer review system, but business schools see it more from the context of practitioners within a community of practice or field. In other words, there are many different forms of truth. What is true for one may not be true for another; thus perhaps it is our responsibility to provide students with contextual truth. Consider the difference between teaching students to critique business practices and merely learning business practices. One teaches students how to think critically and learn through that process; the other merely requires memorizing or rote learning. What we teach is important, but how we teach is even more so. In the latter portion of the above example, we are molding student visions of the world and developing their capability to transform the world.

André discusses what innovation, audience, and learning means to her. In her discussion on innovation, she discusses the sad state of affairs where publishing for publishing sake or using publishing as a method to determine the pecking order of professionals or the most active "thinker" in the field is just not of interest. She is more concerned about the quality of research and being candid about whether a new idea is really a new idea rather than new terminology or more modern examples of earlier thinking. She is not rejecting research but rather calling for us to rethink what research would be useful or responsible: what is new versus what is extended into or uses in new contexts. In Senge's (1990) terminology, the professionals may not actually be "generative," which is not necessarily bad if they are involved in other areas of scholarship that could move more toward interdisciplinary thinking. Gutek feels that research needs to have broader impact on each other as academics;

> meanwhile, we should honor the knowledge base that already exists, admitting that we already know some important stuff that isn't our own. We should assert that applying already existing theories to real-world problems may be just as [or more] important than putting our name on a new theory….This assertion would make our field more relevant and perhaps more understood by the public. (as cited in André and Frost, 1996, p. 50)

In examining audience(s), she indicates that she is her first audience, then her students, followed by her colleagues where we teach each other (or should). Ideally we are a community of scholars, a community of learners, but colleagues seldom learn from each other. To learn from each other,

> we have to admit to our own ignorance, and this is hard to do within systems that value knowing rather than learning, that celebrate experts rather than interactive teams, that are based on politics rather than authentic process…[So] we continue to reward what is measurable and to miss the interesting academic dialogue we yearn for…we do not practice what we preach….and the academic audience defines truth [where she began] rather narrowly and arbitrarily…[finally]

> remember understanding business is crucial to our profession…[but] we have to be careful about making business our target audience. (p. 51)

I propose that the most important gift we can give each other is a comfort zone where we are able to be open and candid about what we do not know, trusting each other enough to be honest. That will move collaboration forward as much as anything else a researcher or project director can do - if they are able to gain buy in from the group. The professor group we have worked with seemed fairly comfortable throughout the faculty development program, openly admitting what they do not know about or do. During the analysis segment, they openly admitted what teaching/learning models, strategies, techniques or procedures they were not accustomed to using or had not tried. This in itself is the most positive foundation to build when developing faculty groups.

Gutek (as cited in André & Frost, 1996) feels that we are not preparing students for a job or a career but rather to understand society and that she is not educating them to fit in but rather to understand their position in the world of organizations. This perspective, although she is in a professional school of business possibly analogous to an engineering and technology school may be argued. I agree we are giving students today's knowledge, methods, techniques, tools when, more importantly, we should be situating our students to be *generative* (Senge, 1990). When she discusses learning, she writes of the same questions that have often come to me: "Why are you changing your courses so often?" or from the outside world "How can you stand to teach the same courses over again?" My response was almost identical to hers: "They are not the same; there is new content, different methods, and/or new issues each time I teach them; they have to change! It is not boring – but the other part of my answer that I do not always express is that I have learned so much during and between each time of teaching each course; my research, travel, reading, conferences, colleagues, and very often my students, especially those who work, teach me so much in so many ways. It may not be always new knowledge, but may be the context within it is applied or employed to solve a problem, and so much more. Both of us truly learn from everyone and every situation; remember always that one's existing knowledge is "a gift that keeps on giving," in that each time it is used, it expands and deepens, becoming greater and different than it was and evolving into new knowledge. IF we are learning individuals and not merely the "learned," there is hope for academics.

Frost, also in André and Frost (1996), explores the academic credibility of teaching and thinks that an open mind about research or teaching along with an expectation of creating, discovering, improving, and generating new understandings when doing either promotes learning as ongoing. Thus it is possible for both roles and functions to feed and enhance the other. Additionally, Mahoney identifies themes on teaching as research and learning:

1. a focus on analytic theory, rather than on description or presentation of best practices
2. an attempt to develop students' abilities to think and employ multiple theoretical models from multiple disciplines…that rarely can a single discipline provide total and complete understanding of a phenomenon or issue…use multiple disciplinary lenses typically enhances understanding

3. an implicit theme is a focus on a form of what might be termed a Socratic method of learning…seek[ing] our conundrums and contradictions…[e.g.] focus on anomalies and use of multiple conceptual approaches. (as cited in André & Frost pp. 118-119)

Mahoney would prefer that students have required studies across disciplines for breadth, which would stimulate understanding and interest. Most importantly, and in this I adamantly agree, this multifaceted approach to teaching and learning also furthers the professors' learning along with the students. They discover, explore, argue, and ultimately learn together - my most preferred type of interaction with my students. As students discover, and we along with them, perhaps this is another type of research lens? For Mahoney, research is all about unanswered questions or issues or contradictions that demand explanation. This can happen with one's own research but also with student research at all levels, undergraduate and the graduate. Mahoney wraps his thoughts with

> the usual conceptualization of teaching and research as separate but joined endeavors in academic scholarship would have blinded me to what I now realize is an inevitable joining of them in a career of learning. The learning I thrill to and enjoy is not possible through teaching or research as a separate endeavor. And I have come to realize that the teaching I enjoy involves research; it stimulates and requires research. Similarly, the research I enjoy would be sterile without the accompaniment of teaching. For me, teaching and research are but different emphases of the same process. (p. 124)

Moving more deeply into and forward in time beyond the 1990 discussions, arguments, and calls for action to more clearly define professoriate roles, functions, and responsibilities and the rewards for particular aspects of their work, Ruben (2004) addresses the discussion and arguments from a quality perspective: *Pursuing Excellence in Higher Education*. Ward's introduction to this volume sets the tone for the content and context as change and the higher education responses to change and how

> change itself has created tensions about the mission and values of higher education….Some are healthy and creative; others are threatening and destructive …[and] are rooted in the interplay of an historic public mission and new market-based strategies….[as] public investments in higher education have yielded public good, but increasingly resource allocations designed to serve that public good are based on market conditions…different but not necessarily irreconcilable values. (p. xi)

Ward sets the context for the discussion about changes in higher education over the past decade as one where the changes are greater in scope and magnitude than any since the 1960s. In describing the shifts in how higher education is funded since WWII (e.g., the growing dependence upon tuition, endowments, and reduced state support), the targeted growth of federal research support, etc. has redefined leadership and management requirements. Higher education institutions have not been clear about their missions, which combined with market forces (public pressure to improve the undergraduate learning experience, changes in revenue sources, financial aid, student access to education, leadership and management strategies, and the growth and success of private for profit education providers) have greatly changed the operational context of higher

education. Critical also is the challenge that information technology brings for the development of new pedagogies, distance learning, and scheduling – all with competition issues.

There is a powerful market of alternative providers, so capacity has become an important issue. Although this is not an issue for us because we have long had excellent articulation with two-year institutions and value transfer students at the general education or major level and/or those who are "spiraling" and are enrolled at more than one institution simultaneously, this has to be carefully monitored so that students do not take unnecessary courses. These situations require high quality advising and the coordination of that advising across institutions - a complex problem for each institution and the students. Also the surge of demand by first generation students has grown in densely populated areas, which has dramatically changed our context and creates quality control, funding, leadership, and management issues requiring nontraditional responses - creative and often "out of the box" responses and, ultimately, a new type of institutional leadership. We have always had a variety of choices for higher education in America; however, more choices are becoming available, and institutions are beginning to define what they consider their "niche" in the overall scheme of choices. "This more highly differentiated range of higher education opportunities may be related to a more competitive market environment for resources and students, but concerns about access and quality remain part of a set of enduring values" (p. xiv). This transformation is in process, relatively undocumented, incomplete, and global in scale and context.

Higher education is an international currency. We are unique in public-private partnerships and the enormous scale that has defined our education. We have an interplay of markets and missions different from anywhere in the world, "expressed primarily through resource reallocations made necessary by the changing demands and needs of society" (p. xv). Although some of these are driven by the market, some new priorities are also driven by the independent efforts to enhance or redefine the mission of higher education to better meet the changing needs of students and to better engage in new ways to advance knowledge. Ruben (2004) ends with:

> the most curious aspect of our role in the advancement of knowledge is our lack of curiosity about higher education as an institution and its place in society… Universities are not only places of learning but also organizations and cultures with their own deliberative and reactive relationships to society at large…often judged slow to change…[They] should also be an arena where debate about public and private values…access and quality…tradition and change…market and value driven decision making are fully and openly explored. (p. xv)

Ruben (2004) describes the academy's response to the criticism from the 1990s and forward as mixed; some have ignored it, considering their institutions and positions historically controversial with a mission of "holding up a mirror to society and challenging conventional ways" (p. 3). To further reflect this point, he quotes Carey in *The Engaged Discipline*:

> Contemporary academics are often embarrassed and defensive about the invidious contrast between the academy and the 'real world'…I take that distinction as a

> tribute, for the relevant contrast is not between the real and the imitation but between the sacred and the profane. The gates of the university mark a passage not only from the city to the campus but from the vulgar and ordinary to the hallowed and unique. (Carey, 2000, as cited in Ruben, p.6)

What are the right questions, if considering that the public does not quite understand higher education's mission? With understanding and the right facts available, would the public's perspective change? Many academics find the discord about their work, their role and function, and their mission (or what they think their mission is) disheartening and demoralizing - also difficult to ignore. Along with the economic pressures of today, K-12 and other organizations are competing for scarce resources in an intense environment. Therefore, many have concluded that we have no choice but to adapt and change. We must not risk obsolescence and atrophy. Noble (2001) is passionate about these issues and argues vehemently about the commercialization of intellectual property and

> the need to reaffirm the traditional ideas of academic purpose and promise…and to recapture the ideological, rhetorical, and political initiative and the moral high ground in the debates about higher education in order to reinvigorate a noncommercial conception of higher education and to re-consecrate the intrinsic rather than the mere value of universities…[and] that faculty represent the last line of defense against the wholesale commercialization of academia, of which the commodifcation of instruction is just the latest manifestation. (p. 32)

I agree, but in my opinion, change must be purposeful with intentional outcomes identified. Ruben (2004, p.7) identifies the critical challenges and thoroughly explores each one:

- Broadening public appreciation for the work of the academy
- Increasing our understanding of the needs of the workplaces
- Becoming more effective learning organizations
  -goal clarification
  -supportive and facilitative processes
  -receptivity to a range of information and information sources
- Integrating assessment, planning, and improvement
  -to identify criteria for organizational effectiveness
  -to recognize leading organizations
  -to promote dissemination of effective practices
- Enhancing collaboration and community [within and between faculty and staff]
  Those who work in academe inhabit an unofficial, yet undeniable caste system. Tenured Ph.D.s constitute the Brahmin etc., followed by untenured faculty and staff members, and research associates, librarians, secretaries, food-service personnel, and finally, the untouchables; physical plan employees. (p.19)
- Recognizing that everyone in the institution is a teacher
- Devoting more attention and resources to leadership
- More broadly framing our vision of excellence
  -academic excellence
  -service excellence
  -operational excellence

Ruben (2004) notes that to move beyond the "ivory tower, perhaps the academy should continue to protect that environment described above, but also genuinely respond to the concerns of its external constituencies, sustain its virtue, and address the necessary by creating a new and more encompassing vision of excellence that takes account of opposing views of higher education's purpose while underscoring the importance, interdependence, and useful tensions among the goals of the academy: academic, service, and operational excellence. In addressing teaching and learning, he uses a framework that identifies two components: 1) courses and programs and 2) student outcomes. He presents multiple dimensions to consider when evaluating the quality of courses, programs, and student outcomes from the perspective of many different groups (e.g. colleagues, students, alumni, employers, etc.) and offers a range of indicators from which to judge success. His final chapter presents a description of a group striving to stimulate and monitor changes in higher education. In "Taking Charge of Change: The Kellogg Commission on the Future of State and Land-Grant Universities," Byrne reviews the agenda for 1996 as 1) the student experience; 2) student access; 3) the engaged institution; 4) a learning society; 5) campus culture; and 6) the covenant or partnership between the public and the public's universities. Their process involved focus groups for each agenda item. Each group has issued reports with recommendations (40) and suggested actions (70) for reform. These groups were followed by the creation of regional groups to further stimulate and support reform. Then, in 2000, the group administered a survey on reform at 36 public universities, addressing items 1-6. Responses were sought from four levels at each institution. They received 90 responses from the 36 institutions (62.5% -36 institutions x 4 levels of responses = 144 possible responses, a 62.5% return). The responses were reported as "reflecting the progress of reform occurring today in the public university" (p. 363). A post-commission workshop "A vision for change" was conducted on the requirements for changing in 2001. The Commission's work has impacted American public education, and its reports have enhanced the awareness for the need for reform. "The integration of learning, discovery, and engagement as recommended by the Commission is being adopted as the core mission at an increasing number of institutions" (p. 364).

Values.

By now, those reading this are beginning to grasp the predicament within which today's higher education finds itself and the context within which the issues about teaching and research exist. However to make sure that I have "beaten the dead horse," I will extend it to include some thoughts from others who have written on the topic of today's higher education and its inherent dilemmas. Kennedy (1997), once president of Stanford University, approached the topic from the perspective of *academic duty*. He believes that the modern American university, with all of its warts, is a "real triumph" and that those who are critical offer no tangible diagnosis or suggestions for a cure" (p. vii). He writes for and about members of the faculty regarding their central roles in the institution's mission and to students. In his opinion, academic duty is the counterpart to academic freedom. His discussion centers on the fact that faculty work is "mysterious to those outside" and that perceived missing information is mistaken for lack of accountability. His comment to future professors is

> that you are entering a life full of the most interesting challenges – and the most important mission that can be found in a modern society. The university is above all else about opportunity: the opportunity to give others the personal and intellectual platform they need to advance the culture, to preserve life, and to guarantee a sustainable human future. Could anything possibly matter more than that? (p. viii)

This description especially resonates with me and with the fields of engineering and engineering technology. When considering Kennedy's (1997) comments in light of a definition that I prefer for technology: "the science of efficient action that extends human potential and capacity," I now add "that extends individual power, thus the collective power of humanity." His description of higher education seems to fit well as the mission to prepare students to research, invent, or develop knowledge or technological advances that in turn "advance culture, preserve life, and guarantee a sustainable human future." (Snyder & Hales, 1981)

The concept of "academic freedom" is misused. Its origin was a result of the anti-Communist sentiment after WWII. At that time, Congress put pressure on universities to fire faculty for past membership in any organization deemed un-American or sympathetic to Communism. Universities resisted that to varying degrees, but the tradition of academic freedom strengthened their capacity to do so. Academic freedom creates

> a treasured space for intellectual experiment – treasured in part because it is safe [to experiment]. In practice such freedom extends further, permitting unusually creative people to lead unusually creative lives. Indeed, academic freedom connotes loose structure and minimal interference…no time clocks and few regulations about the direction of effort or even about the location at which it is to take place. So distinct is the academy from other workplaces that we have developed an informal vocabulary to describe its separation:…the ivory tower, …everything else the real world. (pp. 1-2)

Its counterpart, academic duty is rarely thought about: opposite sides of the same coin. Gardner, in Kennedy (1997), said "of the symmetry between individual freedom and communitarian obligation, 'Liberty and duty, freedom and responsibility: that's the deal'" (p. 2). So, the paradox: American education has never been more successful; more Americans are receiving higher education than ever before, serving more people than ever. Institutions and faculty are highly respected. More people are paying for their children's education. It is still strong; international students come to us from across the globe. We have the strongest university-based research system in the world. It is considered an innovation incubator important to economic development. However, public criticism is at the assault level, coming from both the Left and Right. We are perceived as failing in science and policy studies (e.g., an AIDS cure, a failing K-12 educational system, lack of English speaking teachers or professors, corporations engaged in eternal downsizing, and productivity in higher education). This has caused a serious morale issue in the academy. What Kennedy says about this is important; there seems to be a dissonance between what the public sees as our purpose and what the academy or university sees as its purpose. The freedoms mentioned above, necessary to teaching and

scholarly work, are understood and accepted rather well; however, the counterbalance, that of duty or obligations are

> vague and obscure. Put baldly, there is confusion about what is owed: by the university to society, by faculty to students, by administrators to both. Academic freedom is a widely shared value; academic duty, which ought to count for as much, is “mysterious...[and] no less a mystery within the walls of the ivory tower…[with] little [being] said to new faculty members…about the nature of faculty responsibilities…No job descriptions, no annual performance evaluations [unless on merit system as we are],…The expectations of the professoriate are murky, and public understanding, murkier still (pp. 2-3).

The burden for higher education is greater than ever before; beyond developing students into more knowledgeable, cultured, skilled, and thoughtful individuals, there are now additional and serious expectations that universities undertake: economic development, international competitiveness, research for better health care, and military preparedness. Higher education is truly woven into the fabric of American lives and, furthermore, expected to provide cultural inspiration and athletic entertainment on weekends! The fact remains that when it fails, we are disappointed, and when it is expensive, we become angry. Kennedy (1997) feels that the academy is an extraordinary institution but questions how it came to have so many responsibilities – full of paradoxes.

The different ideas or perspectives about higher education are partly due to individual experiences, but also because each institution is different. With over 3000 four-year institutions in the U.S., there are similarities and great differences (different missions), thus the public's vast array of perceptions. Higher education is perceived as a way to increase social status; some view it as elitist and "stuck up," but too much education is viewed by some as suspicious and they joke about the absent-minded professor. Regardless, higher education is a national tradition, both admired and suspect; it is more successful than ever. Perceived as an institution to produce thinking and working graduates with the ability to communicate effectively, analyze problems, and be reflective about cultural, some see it as simply a credentialing mechanism for employment. Others see it as both, with conflict between the two. There are curriculum content collisions; what should students be required to study, great works or great ideas, Western culture, or to quote Jesse Jackson and demonstrators "Western culture's got to go" (Kennedy, 1997, p. 9). Institutions engaged in great debate, as they should, and curricular change became an external concern, especially in light of the relationship between knowledge and values.

Of course, the way institutions are governed is sometimes suspect, and funding issues have a great deal to do with the intensity of the criticism by the public. So institutions have become good at lobbying for their interests, which has caused them to be perceived in a different light, less special and "just another interest group" (Kennedy, 1997, p. 9). The costs of the educational process have increased dramatically, but when considered in light of "new knowledge" production, each new unit of incremental knowledge costs more than those before. Perhaps our appetite for growth (e.g., the increase in scientific

literature reporting results) needs to be evaluated when considering the high cost implications for universities.

Other perceptions, not often thought about, come into play; the relationships between public universities and private corporations have grown. The public really still views the professor as a bit shabby and absent-minded, but that contrast between the ivory tower and public is broken when professors begin to be perceived as rich and clever. Not only does the public's perspective change about them as individuals, but also towards their institutions. Some feel that universities should not patent – that faculty members have their freedom, are paid enough, and should not really profit from their research. "Academics and profitability don't mix" (Kennedy, 1997, p. 12). On the positive side of the coin, in 1992, survey results, published by the national Opinion Research Center, showed that Americans expressed the greatest confidence in the leaders of medicine, science, and education; the levels were substantially higher, for example, than for the Congress, labor, the press, or the executive branch of the federal government.

Even though the accomplishment is so strong, there still remains a negative public perspective about the nature of the modern university. He summarizes by reminding us that universities are controversial entities, their actions draw public notice and scrutiny because they are important. Kennedy (1997) sees today's style of dealing openly and publicly with problems of the academy as a healthy sign, but also feels that we must be careful that the "publicizing" of issues does not result in them appearing greater than they really are. Although misunderstood and criticized, the fact remains that society needs them, and universities need the public's trust. We must consider the criticism, its origin, and come to grips with our responsibilities, clarify our duty, regain public acceptance, ultimately fulfilling an important obligation to "the society that nurtures us" (p. 22).

> The very heart of the institution's academic duty to society is the work of its faculty…Through the fulfillment of their academic duties, they fulfill the institution's duty to society….It can truthfully be asserted that they *are* the institution. Responsibility suggests the duty one owes to the institution – and, first and foremost, to one's students…classes well prepared, giving a student time, remaining … objective…delivering a full set of institutional objectives…includes, but is not limited to, professional ethics. (p. 15)

Kennedy (1997) thoughtfully and more deeply considers the issues throughout his chapters on "preparation," focusing on prestige perceived by the university and prestige perceived by the public and how the division of labor between teaching and research is affecting the quality of life for many professors, with an environment of faculty members being told to concentrate on research or, if necessary, skimp on research, while also experiencing heavier teaching loads due to financial constraints. Even though the most realistic measure of institution prestige is faculty quality, there are no consistent criteria, as each institution is different. Faculty members have begun to consider other factors: location, careers for spouses, facilities, valued colleagues, the research versus teaching responsibility, and salary, meaning that we cannot really describe a typical career across institutions or disciplines. Institutional prestige is a powerful and conservative concept; however, some aspect of it is an illusion. For example, a Harvard graduate will not

always work at Harvard, so does that mean that they no longer have prestige when employed at a "less prestigious" institution? Harvard, Yale, and Stanford send professors across the nation; perhaps their value system needs adjustment. Another way of looking at it locally is reflected by a professor commenting that he should not have to teach some of the students he has; after all he has a degree from ****. Yet another way of looking at it occurred at a major university committee meeting; some liberal arts and science professors were complaining about the quality of our transfer students and describing their preparation by the community colleges as deficient. Our associate provost at the time quickly said, "Careful, many of the instructors and professors have our (NIU) degrees - what do you have to say to that?" There are so many levels from which to consider prestige that Kennedy calls for a "dose of reality" (p. 58). Research I universities are a small minority of the higher education community.

Kennedy (1997) goes into the duty of teaching as the very core of the university's mission and the faculty's academic duty, discussing how exciting and experimental the best teaching has become. New strategies are being implemented, and technology is revolutionizing the faculty-student relationship, perhaps resulting in a positive outcome of accelerating the more routine work of learning, while reserving for the faculty members the most meaningful forms of interaction with students. However, for young or new faculty members, we cannot yet assure them that teaching is a priority equal to research, but "times are changing. The day may not be far off when teaching performances are routinely reviewed by peers, when senior academic visitors conduct teaching ‘master classes’ as well as give research seminars, and [the ultimate] when candidates are told that teaching is important by department chairs who really mean it[!]” (p. 96).

A direct example occurred here at NIU in the 1980s. A presidential award was created to recognize major researchers on campus; therefore, a committee worked with the provost’s and president's offices to create the award, criteria, and nomination process for the NIU Presidential Research Award. This caused some academic scandal on campus, as those who did not fit the pure or basic research criteria did not fit into the traditional liberal and sciences framework or they were engaged in the other types of research described by Boyer (1990). There was no acknowledgement of, or value for, excellence in teaching or scholarship in teaching; therefore, the committee for the improvement of undergraduate education submitted an argument for creating an NIU Presidential Teaching Award to the President. Thus, we have an equal award in all ways, unless considering individual perspectives on the priority of research versus teaching. The creation of these awards was quite an accomplishment. In my opinion, there should be a third type of award, one that acknowledges those who are thoroughly and productively engaged in both research and teaching that may not fit the direct pure research criteria, where the other types of research are valued and/or where the amount of research may be significant but less than those so highly focused on only research. But in my opinion, Boyer (1990) sets the stage for several different types of recognition. Another aspect of these awards, and I do understand the financial constraints, is that there may be more than three who meet the criteria. It seems to me that once a standard is set, anyone who achieves the criteria should receive the award. I adamantly believe that with the public

focus on teaching and the private partnerships evolving between business and the university, there is a way to fund all who achieve the criteria.

Boyer's (1990) perspective about discovery [research] is ended with the admonition, that

> in addition to scholars, academic[s] are moral teachers. By their own style of conduct, they set examples for the next generation of explorers. It thus follows that part of academic duty is the practice of civility in scholarly discourse – through which we may, by example, encourage the kinds of attitudes and behaviors we see among our most generous colleagues… objectivity and fairness….The university's role…can put scholarship in its proper relationship to other forms of academic duty….It must be in balance with other obligations [duties]…also giving consideration to authorship, priority, and credit. (pp. 184-185)

Finally when addressing one aspect of change – the intensely competitive atmosphere where the central force in that change is the faculty, they remain the heart and mind of the university and their commitment essential. Where creative energy and institutional loyalty exist, faculty members are willing to engage in experimentation; where it does not, they do not. Interesting to note is that Boyer (1990) says the elite institutions are not the ones where innovation and commitment are evident, but instead the level below that top rung of institutions is where transformation is taking place. He also mentions that in more stable environments, faculty engagement on this front is weaker, requiring new ways to make faculty feel responsible for the institution and students. He feels shared governance is part of the equation so faculty members feel like stakeholders. NIU has this. Leadership is critical, and leaders must advocate openly for their own faculty and public understanding of them and their work. Institutional redesign must consider these and other dimensions while reclaiming its central mission as society's agent for cultural transmission and cultural change by working through thoughtful participatory transfer of knowledge and excitement from one generation to another, always putting students and their needs first. Then the rest will fall into place, including the tension between research and teaching. This will, however, require attitudinal change and the emergence of a new understanding of academic duty.

The next two works are in agreement about the issues discussed above, the history and many public perspectives, so it may be important to make only a few of their points not directly addressed above. For example, although shared governance is mentioned above, O'Brien (1998) makes the point that the dual authority of faculty and administration, or what some label as shared governance, is one of the reasons that most world-class universities are American ones. He believes that we are strong because we have both strong faculties and strong administration. Also in agreement with the above authors, but more directly, he is impressed with the persistence of the moral mission of the modern university. Another important aspect of his perspective is that the critical discussions about higher education are mistaken due to their focus on the *idea* of higher education rather than the *institution* of higher education (p. xviii). His identification of "half-truths" uses the definition that "what is claimed is essential but not absolute" (p. 5) and presents the following half-truths:

- The faculty is the university. He argues this through an historical perspective, ending with a thought important to us: "understanding the role of faculty in the research university is the prime task in clarifying the nature of the modern institution. (p. 9)
- Tenure is the necessary condition of academic freedom - not the same as academic freedom. These two are not the same thing. Tenure is a contract for employment.
- Universities are neutral on moral value/universities teach moral values - these two thoughts do not add up to a whole truth. There must be "even moral" value embedded in the collegiate experience, but where?
- The liberal arts curriculum aims at distribution/diversity. Distribution means a well-rounded education – at best a gesture, at worst a futile gesture.
- Diversity on both moral and intellectual grounds is proclaimed by institutions, but what does it really mean? It is often a "code" word and has little meaning in either sense.
- Teaching is the primary task of higher education. Most will not outright deny this claim. He feels that "the emphasis on teaching – and the much-publicized conflict between research and teaching – is downright misleading….The proper issue is not so much the faculty teaching as it is the students learning. The neglected topic in university assessments is not teaching; it is [student] learning – with or without teachers [faculty]." (p. 12)

The others include the problems with higher education: the administration, low-cost public education benefits the least advantaged, and the university is the axial institution of modern society. Each of the half-truths is more deeply explored.

It is important to note that the Illinois public has issued "A Citizens' Agenda for Illinois Higher Education - The Illinois Commitment: Partnerships, Opportunities, and Excellence" (IBHE, 1999; Statewide Progress, 2005). Goal 2 "Higher education will join elementary and secondary education to improve teaching and learning at all levels" directs us to build further strengths in the educational process and outcomes (p. 4). The progress report indicates that Illinois graduates, who were studied in a pilot study to develop a model for collecting and analyzing data at the post secondary level, have higher levels of literacy, and are better prepared for the baccalaureate level. Additionally, problem solving skills, reading comprehension, and writing are improving. Important to note is that this data is from a very small sample, thus the data are preliminary at best; a larger sample could contradict these results. There is a direct tie to our college initiative from a "state" directive.

The authors above describe the debate and issues within the debate regarding higher education. We are especially interested in those about faculty research, the Scholarship of Teaching as acceptable faculty research, and how to make research on teaching an acceptable, encouraged, supported, and respected area of research for promotion and tenure within the engineering and technology context. As important is our interest in evolving faculty teaching and student learning to higher levels. Therefore, we expect the

outcomes of this endeavor to impact several very important "fronts" in our educational endeavors in CEET at NIU.

Principles to Improve Undergraduate Education

Chickering and Gamson, through The American Association of Higher Education, first published the "Seven Principles for Good Practice in Undergraduate Education" in 1987 and then "Applying the Seven Principles for Good Practice in Undergraduate Education" in 1991. Hatfield (1995) explains that the principles were not new then and that historically, about 350 years ago, Comenius called for active learning: "Let the main object of our didactic be to seek and find a method of instruction by which teachers may teach less so that learners could may learn more" (p. ix). Another important statement by Boyer (1990) was "I would like to hear, at least occasionally, 'Teach or Perish.'" rather than publish or perish (as cited in Hatfield, p. ix). Since then the Seven Principles have received a great deal of attention, as universities have begun their implementation in a myriad of ways. The principles and indicators of educational effectiveness for each are

Principle 1: Good Practice Encourages Student-Faculty Contact
Frequent student-faculty contact in and out of classes is the most important factor in student motivation and involvement. Faculty concern helps students get through rough times so they keep on working. Knowing a few faculty members well enhances students' intellectual commitment and encourages them to think about their own values and future plans. Indicators of effectiveness are (Hatfield, 1995, p. 110)

- Overall student-faculty ratio
- Average section size
- Percentage of sections with 15 or fewer students enrolled
- Percentage of faculty who report knowing the majority of their students by name
- Percentage of students involved in faculty research
- Students' overall frequency of out-of-class contact with faculty
- Student's opportunity for in-class discussion
- Percentage of students reporting having visited faculty during established office hours
- Average number of hours faculty spend advising each week
- Percent of students reporting after-class conversations on academic subjects with faculty

Principle 2: Good Practice Encourages Cooperation among Students - Cooperative Learning Communities
Learning is enhanced when it is more like a team effort than a solo race. Good learning, like good work, is collaborative and social, not competitive and isolated. Working with others often increases involvement in learning. Sharing one's own ideas and responding to others' reactions improves thinking and deepens understanding. Indicators of effectiveness are (Hatfield, 1995, p. 110)

- Percentage of faculty who report efforts to create group projects or learning communities in their classes

- Percentage of courses that include team projects or similar group learning experiences
- Percentage of students participating in group study
- Percentage of students reporting frequent out-of-class discussions with fellow students on course content
- Use of non-competitive grading techniques (competency-based, criterion-referenced vs. use of the normal curve)

Principle 3: Good Practice Encourages Active Learning
Learning is not a spectator sport. Students do not learn much just sitting in classes listening to teachers, memorizing pre-packaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences, and apply it to their daily lives. They must make what they learn part of themselves. Indicators of effectiveness are (Hatfield, 1995, p. 110)

- Percentage of faculty using teaching techniques that involve students' active participation
- Number of internships, practical, or other practice-oriented courses offered per student
- Number of independent study courses offered per student
- Percentage of graduating seniors engaging in at least one internship, practicum, independent study, or similar practice-oriented course (this assumes high quality planning, execution, leadership, and requirements for each, especially independent studies)
- Percentage of courses requiring students to engage in independent research papers, projects, presentations, or similar exercises
- Percentage of courses requiring students to use the library as a research resource
- Percentage of faculty reporting giving students credit for active class participation
- Percentage of students reporting using the library as a result of class assignment
- Percentage of graduating seniors reporting opportunities for field projects in courses during their career

Principle 4: Good Practice Gives Students Prompt Feedback
Knowing what you know and do not know focuses learning. Students need appropriate feedback on performance to benefit from courses. In getting started, students need help in assessing existing knowledge and competence. In classes, students need frequent opportunities to perform and receive suggestions for improvement. At various points during college and at the end, students need chances to reflect on what they have learned, what they still need to know, and how to assess themselves. Indicators of effectiveness are (Hatfield, 1995, p. 111)

- Average number of graded assignments or exercises given per course
- Average number of graded tests and quizzes per course
- Average "turnaround" time for submission of final course grades

- Percentage of students reporting that they generally received graded assignments back from professors within one week
- Percentage of students reporting that professors provided frequent and specific oral comments on performance
- Percentage of students reporting that the professor systematically reviewed tests or assignments in class after papers were returned
- Percentage of graduating seniors reporting that frequent professor feedback helped improve their undergraduate performance

Principle 5: Good Practice Emphasizes Time on Task
Time plus energy equals learning. Efficient time-management skills are critical for students and professionals alike. Allocating realistic amounts of time means effective learning for students and effective teaching for faculty. How an institution defines time expectations for students, faculty, administrators, and other professional staff can establish the basis for high performance for all. Indicators of effective are (Hatfield, 1995, p. 112)

- Average student course load taken per term
- Percentage of courses with clear attendance policy
- Average amount of time spent studying for class or working on assignments per week
- Average number of hours per week spent on academic assignments as reported by graduating seniors
- Percentage of available library spaces occupied by students from 5-9 p.m. (which has changed with technological advances with online access to information)

Principle 6: Good Practice Communicates High Expectations
Expect more and you will get it. High expectations are important for everyone – for the poorly prepared, for those unwilling to exert themselves, and for the bright and motivated. Expecting students to perform well becomes a self-fulfilling prophecy when teachers and institutions hold high expectations of themselves and make extra effort. Indicators of effectiveness are (Hatfield, 1995, (p. 113)

- Average ACT/SAT of entering freshmen
- Average number of pages of reading and writing assignments in humanities and social sciences courses (engineering and technology courses as well)
- Overall distribution of grades granted each term
- Percentage of seniors graduating without writing a major research paper during their undergraduate career
- Percentage of students reporting not being significantly challenged by class material and assignments

Principle 7: Good Practice Respects Diverse Talents and Ways of Learning
There are many roads to learning. People bring different talents and styles of learning to college. Brilliant students in the seminar room may be all thumbs in the lab or art studio. Students rich in hands-on experience may not do so well with theory. Students need the opportunity to show their talents and learn in ways that work for them. Then they can be

pushed to learning in ways that do not come so easily. Indicators of effectiveness are (Hatfield, 1995, p. 113)

- Percentage of courses requiring students to speak in class and percentage requiring students to view visual material as part of assignments
- Percentage of students reporting that they were encouraged to ask questions in class
- Percentage of students reporting that the grading and evaluation process used by the professor allowed them to actually demonstrate what they knew
- Percentage of students reporting that performance evaluations permitted demonstrations of competencies in different ways
- Percentage of faculty reporting that they regularly use individualized or alternative forms of instruction to communicate course materials
- Percentage of faculty reporting knowledge about, and use of, formal differences in learning styles among students to organize their courses

In consideration of Quality Indicators for an Educational Environment, Pascarella and Terenzini (1991) identified the following impacts on educational environments (as cited in Hatfield, 1995, p. 108)

- Living on campus is a critical variable to college impact, so student experience other forces of change on campus
- Informal, non-classroom contacts between students and faculty are responsible for increases in intellectuality, maturity, autonomy, educational aspirations/attainments, and interpersonal skills
- Teaching methods that stress active learning produce a wide range of intellectual and personal effects
- The academic major influences what students know about the field
- Relationships with peers, while not as influential as faculty relationships on intellectual development, are important to other areas of student maturation

Learning Communities

This section will present concepts, theory, principles, thoughts, models, and practices on learning communities. It is not possible to consider learning communities as an isolated concept; therefore, the content to be presented will be messy. It will flex back and forth between what a learning community is and how to structure and develop one, while addressing the inherent concepts, theories, principles, definitions and more. For example, in creating such a community, one has to understand something about learning in general. A great deal of the literature from which we hope to be informed is about K-12 learning communities of teachers; another focus of the broader literature is about student learning communities or teacher-student/faculty-student learning communities. All the authors present a great mixture of information valuable for our consideration. Finally, messy means that the information is so interrelated that it is difficult to present linearly. For example, one might assume that I could define learning communities and then go from there - peeling back the layers of the topic, or begin with a foundation definition and build from there, but that linear thought process cannot be applied to an integrated concept or entity such as a learning community. Hopefully, however, one reading this

will at least begin to create one's own foundational framework or schema from which to build one's own understanding and meaning; expand and deepen what it will mean individually; and then stimulate engagement with the group to create the faculty learning community, its operational context, and perhaps beyond that faculty/student LCs.

In this section, we will try to show the relationships between the multiple intelligences (MI), knowledge(K), learning(L) and its processes, and change through learning organizations (LO), learning communities (LC), learning circles(lc), communities of practice (CP), and communities of Interest (CI). We have constructed our own models and processes and identified our own program content. Let us begin by considering first what might describe a learning organization. Without a doubt, Senge's (1990) seminal work on learning organizations, *The Fifth Discipline*, is the premiere work describing learning organizations and inherently the learning person. His work with other contributing authors on *The Dance of Change* (1999) and *Schools that Learn* (2000) informs us as well. These works will be used to establish the foundation for our learning community and faculty circles of team members.

Senge (1990) uses the engineering discipline to describe how an idea moves from invention to innovation. He says that particular "component technologies" come together where isolated developments across diverse fields of research come together in an "ensemble of technologies critical to each other's success" (p. 5). Until this ensemble forms, the idea cannot move forward and achieve its potential in practice. Along that line of thought, he describes five component technologies that converge to result in innovation in learning organizations. Each is critical to the others, each a dimension in building the capacity of organizations to learn, resulting in greater capacity to achieve higher potential. The components are systems thinking, personal mastery, mental models, building shared models, team learning. Each of these dimensions is a discipline, each a body of theory and technique to be learned and put into practice. Each is a discipline or developmental path for acquiring competencies or skills. Neither a person nor an organization ever truly "'arrives' at 'the place' where they have mastered all they need to know or learn, for that is forever changing; one never arrives at excellent, for that bar is always being raised; but an individual or an organization can practice the disciplines of learning and become better or worse" (pp. 10-11). When the component technologies converge, they create a new wave of experimentation and advancement, not *the* learning organization but rather an organization that is always "engaged in learning" (p. 13). True learning, whether in an individual or an organization, requires "metanoia" – a shift of mind. In Greek, it meant, "a fundamental shift or change, or more literally, transcendence ("meta"--above or beyond, as in "metaphysics") of mind ("noia," from the root "nous," of mind)" (p. 13). To grasp its meaning, that of metanoia, is to grasp the deepest meaning of learning. Learning involves a shift of mind, which goes far beyond taking in of information. For example, if one reads a book on bicycling, one cannot really say that he/she has learned how to ride a bicycle. Real learning means that "we re-create ourselves. Through learning we become able to do something we never were able to do. Through learning we re-perceive the world and our relationship to it. Through learning we extend our capacity to create, to be part of the generative process of life" (p. 14). Furthermore, this is not only the meaning for learning in humans, but also what the basic

meaning of learning is in a learning organization – "an organization that is continually expanding its capacity to create its future…not merely to survive…or adapt [to] learning…but to join adaptive learning by generative learning, learning that enhances our capacity to create" (p. 14). This definition of learning truly changed my life and perspective about my own learning and my teaching practice. The sense and understanding from Senge's work, that learning is the "re-creation of one's self" where one "becomes able to do something that we were never able to do…that we re-perceive the world and our relationship to it" differently has great meaning and insight when truly understood (pp. 13-14). This became the goal for my students and me. Understanding something of each of the component technologies builds deeper understanding about learning.

We will begin and end with the *Fifth Discipline, Systems Thinking*. We are all systems and bound by the interrelatedness of actions on each other. It is almost impossible to be aware of the impacts our actions have on others; for in time and space, we may not be together. Therefore, we cannot see the whole pattern of change; we can only observe the snapshots of isolated parts of the system, which makes it difficult to understand the deepest problems. Systems is a conceptual framework where one can use a body of knowledge and tools to make patterns across systems clearer and then see how to change the patterns that have negative or less than positive effects. Because patterns creep up slowly, we are not aware of them, and thus, they can do great damage. A parable to exemplify that is the "boiled frog." If one puts a frog into a pan of lukewarm water, he will sit quietly while you turn up the heat. The heat will gradually come to a boil and literally boil the frog to death. That is the way of slowly developing negative or harmful patterns. They gradually do great harm or damage, and because they are systems-oriented, we cannot always see them develop unless we use tools and techniques to study and change them when necessary and in time. Conversely, we react to crises much as a frog would. When one puts a frog in a boiling pan of water, he immediately hops out. He senses the danger of the boiling water. Thus we often spend our time dealing with crises but fail to realize the gradual development of dangerous patterns can also cause great damage. But as part of systems, it is difficult to discern the patterns that develop when looking through the lens of only one person or department. We must consider the whole, the system, to really understand events across time and space and their interconnectivity, thus interrelated effects. This component has clear implications for the interconnectivity that several of the authors above present between teaching and research – an integrated system where one cannot exist without the other. The first discipline in Senge's (1990), Personal Mastery, may be interpreted to mean "dominance over people or things" (p. 8). However, in this context of Senge's learning definition, it means special level of proficiency. People with a high level of personal mastery are able to consistently realize the results that matter most deeply to them. In effect, they approach their life as an artist would approach a work of art, committed to their own lifelong learning. It is a discipline of continually clarifying and deepening our personal vision, of focusing our energies, of developing patience, and of seeing reality objectively, an essential cornerstone of the learning organization (and the learning individual).

An organization's capacity for learning can be no greater than that of its members because few organizations encourage the growth of their people, which results in vast untapped resources: people enter business as bright, well-educated, high-energy people, full of energy and design to make a difference. By the time they are 30, a few are on the “fast track” and the rest “put in their time” to do what matters to them on the weekend lose commitment, sense of mission, and excitement. Those with personal mastery live their lives to their highest aspirations, in other words, always learning through self actualization. Once again, personal mastery must be, or should be, a core competence of any professor. Personal mastery is all about the continuous, and often subliminal, seeking of learning that personifies the very best of the professoriate. There is a quiet, often very personal, need and drive to learn; these professors are never “still.” They are always seeking new projects, research, changing their approach in class, moving in new directions. Senge’s (1990) discipline of personal mastery describes the underpinning motivation of true learners. This concept, to me, also clearly separates the “learning” from the “learned.”

Mental Models, the second discipline, are those "deeply ingrained assumptions, generalizations, even pictures or images that influence how we understand the world and how we take action" (Senge, 1990, p. 9). Later, this will be connected to knowledge as "frameworks," or "structures" and assumptions as "paradigms" within which we operate to learn or remain the same. Senge and the authors below all mean about the same thing; our mental frameworks are embedded assumptions that lead us to take or not take action. To take action, make a change, or learn would require adjusting or changing internal assumptions that guide one's decisions or actions. It is a type of "schema" in terms of information processing or framework of knowledge and experiences. Mental models guide our interactions in life; therefore, to consider new directions or learn new knowledge, we must change our mental model by turning the mirror inward and engaging in critical reflection (to use a term later used herein). This means that we challenge our internal pictures of the world by surfacing them, scrutinizing them, and then carrying on "learningful" conversations that bring a balance to inquiry and advocacy. We voice our own thinking (later referred to as finding our own inner voices) effectively, possibly influencing others or being influenced by them. We hope we have stimulated this in our initial professor group and that the faculty development program’s analysis aspect is based upon the very foundation of “critical reflection,” where open and critical self reflection leads us and motivates us to change.

The third discipline, Building Shared Vision, is building a picture together of what we can be or what we would seek to create together, the capacity to hold a shared picture of the future we seek to create. When authentic and there is a "genuine vision" rather than merely a statement of vision, people learn and excel because they can visualize where they want to be and because they want to. Sometimes visions, good visions, get stuck in one mind and are not shared. Thus, shared visions simply means "involving people in the skills of unearthing shared 'pictures of the future' that foster genuine commitment rather than compliance" (Senge, 1990, p. 9). At best we hope to have begun some of the participating faculty members on a path of sharing a different vision for teaching and learning across the college. We realize that we have only just begun to present the

opportunity, develop the path, and try to motivate some of our faculty members to enter the pathway.

Finally, the fourth discipline, Team Learning, involves "dialogue, the capacity of members to suspend assumptions and enter into genuine [authentic] 'thinking together'" (Senge, 1990, p. 10). Once again, to the Greeks dialogue meant "a free-flowing of meaning through a group, allowing the group to discover insights not attainable individually" (p. 10). Dialogue is quite different than discussion or conversation; it involves "learning how to recognize the patterns of interaction in teams that undermine learning. Patterns of defensiveness are often deeply engrained in how a team operates [these patterns can limit a team’s learning and insights]. If unrecognized, they can undermine learning. If recognized and surfaced creatively, they can actually accelerate learning" (p. 10). Team learning is critical, where teams, not individuals, are the learning unit. If teams learn, organizations learn; if teams cannot learn, then organizations cannot learn. This concept sets the stage for learning communities but is not something that happens immediately. We believe that our small group engaged in a great deal of individual learning, a lot of conversation, and some dialogue. There was some team learning, but we are at the very beginning level of team learning. True team learning is something that will expand and deepen with more opportunities to work together, and let’s face it, we had a lot to accomplish individually in the “self-critical reflection” aspect of the program before we could move to “critical reflection as a group.”

It is important to note, however, that our particular group did not seem intimidated by examining themselves, their philosophies, and professional practices, and they seemed to openly engage in critical reflection. They made major changes to their courses, syllabi, and tests, adding performance assessments and more. They openly documented their strengths and weaknesses. They did not shy away from, nor withdraw from, “critical” self-reflection. I believe this is because they all genuinely care about their teaching and student learning. But to broaden and deepen team learning, where the sum of the individual learning is truly greater than the number on the team, is a step we hope to take next. Let us wrap these thoughts by revisiting the fifth discipline, Systems Thinking, as it is the discipline that integrates the others: "fusing them into a coherent body of theory and practice" (Senge, 1990, p. 13). Mental models lead to openness and ability to discover weaknesses. Team learning engages groups in looking for the larger picture, and personal mastery engages each of us in the personal motivation to continue learning and growing. Otherwise, we would be reactive (“others create my problems”) and where we would not "own" any part in creating our own problems. The integration of the whole enlightens us and we begin to re-perceive ourselves and our relationship to the world. Learning is a "shift of mind - from seeing ourselves as separate from the world to connected to the world, from seeing problems caused by someone else or something 'out there' to seeing how our own actions create the problems we experience” (p. 13). A learning person and a learning organization are where that individual and those people continually discover how they create their own reality. They engage in “creative tension” by holding a vision and concurrently telling the truth about the current reality relative to that vision. Creative tension can be used to “lead people to see more aspects of reality as something they can individually and/or collectively influence….and, how they can

change it" (King, 1986; Senge, 1990, p. 357). A learning organization or a learning person or team occurs when people are continually discovering how they can create their own reality or change it.

In *The Dance of Change* (1999), Senge, Kleiner, Roberts, Ross, Roth, and Smith establish that change must be led from top down because nothing can happen without the CEO or Dean on board or buying-in. However, they go on to acknowledge that little or no significant change will occur if change is ONLY driven from the top. There must be genuine commitment and learning capability throughout the organization – in our case, the college. Thus, we began with a small but committed group, at least at the level of being willing to complete all aspects of the faculty development program and to continue with the experimental research in the classrooms, submitting research publications and participating in presentations. There seems to be a commitment by the professor group, as well, to revise their other classes at some point in time, although that level of commitment remains to be examined at a later point. Some professors seem to be interested in becoming the faculty development leaders to sustain the program; therefore, we have leadership at the top and evidence of rather strong faculty commitment. (Long term commitment cannot be addressed at this point.) When considering leadership, obviously we are not talking about the Dean as the only primary since this program was developed and led by a professor and NIU professional staff member. The Dean empowered them by acknowledging the need, leading the challenge for change, and supporting the program and development. This exemplifies true empowerment and transforming leadership (Burns, 1978) and superleadership (Manz & Sims, 1989; Pearce et al, 1994; Yukl, 1989), where the leader raises him/herself and others to higher levels of aspiration and develops others into leaders, which leads to community building and leaders known as “network leaders” or “community builders” (Senge et al., p. 17).

In moving to acknowledge Boyer’s (1990) Scholarship of Teaching, one must first build a community, leadership, a foundation for networking, knowledge, and support for learning and action to result. The challenges along the way are simply stated by Senge et al. (1999): “We don’t have time for this stuff!” “We have no help!” “This stuff isn’t relevant!” “They’re not walking the talk!” ”My situation (my students, my course) is different!” “We keep reinventing the wheel.” “Where are we going?” “What are we here for?” In our initiative, we tried to address all of this up front, and I believe we did that fairly successfully. The Dean and program leaders backed up all theory with research or nationally recognized practice. Each program goal was justified by national standards, accreditation criteria, or communities of practice demands. The initiative goals were clearly established. Professors were provided time and stipends to participate; they were fully supported; and the Dean was active and visible. Professors were given a complete “tool box” of materials – copies of all major literature, the draft of this review, nationally recognized sources to guide practice and process, national standards, and more. They were led through the entire development process. In our case this meant they actually redesigned and developed their courses, selected new teaching strategies, designed and developed new tests and performance assessments, and much more while together with the program leaders throughout 18 days. They were expected to have to do very little outside of “class” time. They were paid a stipend, one half at the end of professional

development and one half upon completing their research manuscript. Some program days were during the normal semester, and some were during the summer. We tried to accommodate every challenge and potential resistance in the program design, at least to get the initiative started towards the Scholarship of Teaching in the college.

In *The Dance of Change*, Senge et al. (1999) make a point that is truly the foundation for any "profound" change. Is the change to be "authority" or "learning" driven? (p. 41). Authority driven change is easier to organize and can be more easily effective short term. However, deep and potentially sustainable change, where change continues to occur, is driven by learning, where there are

> repeated opportunities for small actions that individuals could design, initiate, and implement themselves…first on a small scale and then with increasingly larger numbers of people and activities, [where] people articulate the goals they would like to achieve, experiment with new projects and initiatives, learn from their successes and mistakes, and talk with each other, candidly and openly, about results…draw[ing] in new people who share similar values and aspirations" or who learn that they do (p. 41).

This is where we want to be with our initiative and is why we began with learning as the foundation and operational context – the ultimate meaning of learning is change. Senge's group identified the qualities in which the most important change initiatives seem to be grounded:

- They are connected with real work goals and processes;
- They are connected with improving performance;
- They involve people who have the power to take action regarding these goals;
- They seek to balance action and reflection, connecting inquiry and experimentation;
- They afford people an increased amount of "white space" opportunities for people to think and reflect without pressure to make decisions;
- They are intended to increase people's capacity, individually and collectively; and
- They focus on learning about learning in settings that matter. (p. 43)

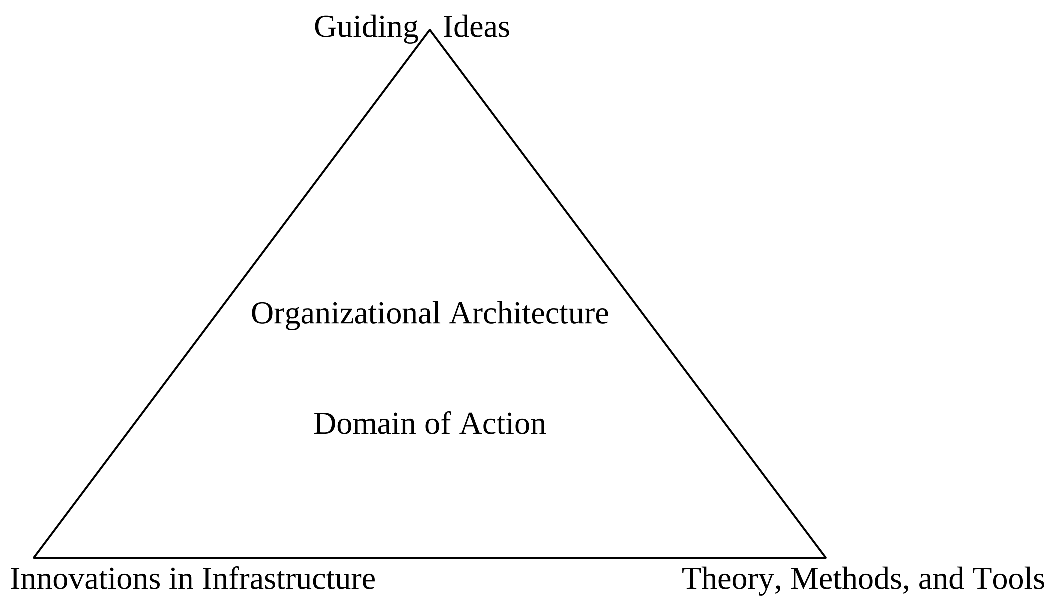
This is how we tried to develop our context for this change initiative, although we did make many instructional, teaching and learning decisions. Clearly, the participating faculty were supported to make changes related to goals, processes, and performance and were supported to inquire through experimentation, etc. The whole endeavor was about learning; however, not just student learning – but about their responsibility to be "learning" faculty members if they were to truly model and be capable of leading students to learn. This requires "aspiration…reflective conversation…understanding complexity…capabilities all learners must have" (Senge et al., 1999, p. 45). People are passionate about producing results, but they must see that it matters, that their colleagues take it seriously, and that because it works – it gets results. We tried to design our program to reflect these operational premises. We recognized that commitment initially was only possible with a selected small group of professors; however, our goal is to grow steadily by providing useful tools and processes in a supportive context. We have tried to

discern our limitations, understand the current reality and practice, acknowledge existing mental models, and situate professors to prove what works to themselves and their colleagues through experimentation. We realize that although we engaged them in 18 eight-hour days of development, this is not realistic for the long term. However, now that the program has been piloted, we know where to revise and modify it in content and process – very possibly with a shorter time requirement. There are challenges that we will need to address and consider, and we need to remember that we are initiating a culture change in teaching and learning and also in what is acceptable and encouraged as scholarship and research. For an engineering and technology college, this is a major culture shift to include and develop respect for the scholarship of teaching, even with a long productive history of research on K-12 education.

Another aspect of that culture change is collaboration – learning communities. We are seeking to engage faculty members in individual and collaborative scholarship on teaching and learning. Although many faculty members collaborate on research and private contracts, the culture does not include collaboration on teaching; therefore, this is a new shift as well. And, regarding ongoing assessment and evaluation, we hope to modify our faculty evaluation, promotion and tenure criteria to reflect the culture and scholarship changes. (That is part of the phases to follow the program and classroom pilots' analyses and results.) This will be reflected in revised bylaws and faculty evaluation criteria. Since we are a "shared governance" institution, the bylaws require a 2/3 majority vote; however, we do not expect difficulty since we are striving to broaden opportunity rather than restrict or increase the level of productivity.

In *Schools that Learn* (2000), Senge, Cambron-McCabe, Lucas, Smith, Dutton, and Kleiner clearly establish that a school, whether K-12 or college level, is a "fulcrum point for educational and societal change" (p. 6). They make a very good point that classrooms can only improve if the schools and communities improve and that learning schools are not so much a separate place as a meeting ground for learning – dedicated to the idea that those involved, individually and collectively, are continuously expanding their capabilities through learning as described in *The Fifth Discipline* within the context of a community. In a learning community, everyone is involved in learning and supporting learning. The illustration below shows that the domain of action requires guiding ideas, innovations, theory, methods, and tools to make change happen in a way that it can endure. In other words, awareness changes sensibilities, attitudes and beliefs, skills and capabilities, resulting in a deeper cycle of learning.

Figure A.6.1: Domain of Action



(Senge, et al, 2000, p. 26)

Senge et al. (2000) define learning as connections in which one of the most challenging aspects is to get teachers to understand that there are others in the classroom with them and that they are teaching students <u>and</u> subject matter. Knowledge is separated from the knower, where teachers deposit "tokens of codified knowledge, discrete pieces of information, into students' heads" (p. 21). However, fields of knowledge do not exist separately from each other, nor are they separate from those who study them. "Knowledge and learning – the processes by which people create knowledge – are living systems made up of often-invisible networks and interrelationships – a complex living system" (p. 22). This greatly affects the ability for individuals or groups to learn.

> All learners construct knowledge from an inner scaffolding of their individual and social experiences, emotions, will, aptitudes, beliefs, values, self-awareness, purpose, and more. Thus, one's learning is determined by understanding, who you are, and what you already know – the schema or framework that one connects new learning to. Learning is affected by what is covered, how it is taught or learned, and who teaches it. These connections or disconnections can strengthen or weaken learning. (pp. 167-168)

Teaching and learning are driven by vision, according to Senge et al. (2000), making it more possible for those responsible for the educational process to understand what they are trying to accomplish. So in considering an educational vision, are we trying to "socialize young people so they fit into society…train a workforce…introduce young people to greater possibilities for their lives?" (p. 168). The most profound answer is "helping young people learn how to create the lives they truly want to create" (p. 169). To accomplish this creative process, a necessary key is "structural tension" - contrast. Tension creates a need for resolution; the "contrast is a state between our desired state or goals, aspirations, desires and our current reality. In resolving the tension by taking

actions, we achieve our goals or future state" (pp. 167-168). To describe the context within which we are working, it might help to consider Senge et al.'s perspective of disciplines as unnatural; in other words we must define the desired result and define reality objectively by removing ourselves from our assumptions, theories, and concepts. That requires discipline, an unnatural state, to achieve the objectivity, ultimately learning from mistakes. Discipline is what builds the capacity to maintain structural tension – creative tension that can result in change. When one has great capacity to establish and maintain structural tension, there can be great personal mastery; otherwise, whenever someone becomes uncomfortable, he/she will give up. Another requirement is to ask students what they want, but differently than how we typically ask the question. Typically, when students are asked that question, it is within a realm of established possibilities – out of what is made available. This is compliance oriented. The difference between that and a better way to ask the question is to ask in a way that allows responses not on the menu of acceptable possibilities. That way, we are not suggesting that they limit their aspirations to something reasonable but rather that they become "creative" or "self-generative," realizing choices not already established or considered what they "should" want (p. 170). If we teach them to love being creative and generative, then students will be motivated to learn what they need to learn to accomplish what they want to create or what they need to change to accomplish their goals. Furthermore, we need to steer away from what Senge and his colleagues call the "perfectionist virus" or the "canned answer": in other words, learning that results in the expected answer or evidence of learning process. This can result in students feeling they are not learning anything of value because they realize the right answer is to mimic the ideal end product expected "rather than understanding the requisite knowledge and strengthening their learning process" (p. 184). When students feel they are not learning anything they can really use, their motivation decreases and they lose interest, often becoming low performers even though bright and capable. If they feel they cannot "mimic the answer effectively that it is their fault….The safety net for taking risks is removed; they will no longer be permitted to fail….They become anxious, unsatisfied perfectionists, guilty procrastinators, or both. Self blame can spread from student to student…ultimately shutting down learning and flow of information" (p. 185).

Senge et al. (2000) support "assessment as learning" (p. 205) (also discussed further later). Considering <u>formal</u> (explicit, codified facts), <u>applicable</u> (transferring knowledge into action), and <u>longitudinal</u> knowledge (capacity to act effectively over time, using knowledge more effectively and innovatively), good formal tests do not assess learning authentically nor do they reveal the progress students are making or motivate students to reflect upon what they know and what they still need to know or learn. Instead "we need assessments that are designed for learning, not assessments that are used for blaming, ranking, and certifying…requir[ing] a shift of attitude about testing and learning. We need evaluation that is more informed" (p. 205). The qualities they suggest for assessment for learning are *timeliness*, or immediate and ongoing feedback; the timeliness of the feedback directly impacts its meaningfulness and value to the student. *Honesty* is another quality that is critical, as it causes "disequilibrium" or "cognitive dissonance," making students face the feedback data and what is means, possibly the need for change. *Reflection* may be one of the most important qualities where the learners

realize their "spiral" of learning or progress. Their reflection reveals that they have made progress through the plan, take action/experiment, assess/gather evidence, study/reflect, and modify actions based on new knowledge spiraling cycles. We do not build in enough reflective time so students can see where they are and what they still have to learn – self-evaluation – or how to plan and organize their own learning based upon what they learned from the feedback. The intellectual behaviors we want to instill are

- to persist in learning, using alternative strategies if solutions are not immediately apparent; to decrease impulsivity –
- to think through the problem and use the problem solving process and alternative strategies;
- to listen to others and to understand others' points of view – some feel this is the most intelligent behavior;
- to think with flexibility – once again considering alternative points of view rather than their own way as the "only way" to solve a problem;
- to employ metacognition – being aware of their own thinking processes…They can describe their own processes and are able to evaluate themselves; striving for accuracy and precision, making sure that their work is complete and accurate, reflecting on it before turning it in to quickly;
- to have the ability to question and pose problems, risking others' opinions;
- to have the ability to use past knowledge and experiences in different contexts, abstracting learning from one meaning or experience to another;
- to have the capacity for ingenuity, originality, insightfulness, creativity – capability to be generative;
- to have the ability to express themselves and their thoughts with precise language;
- to have the ability to gather data using all the senses; demonstration of a sense of humor; inquisitiveness;
- to have cooperative intelligence and social intelligence – learning and working with others successfully. (pp. 197-205)

One of the most illuminating sections in *Schools that Learn (2000)* is about pedagogy and literacy. In thinking about pedagogy, one might want to consider what literacy has meant – "educated, learned" (p. 210). Or one might want to realize that in teaching students to become literate, literacy has become "literacies," no longer meaning just reading, writing, speaking, or fundamental mathematics. Today, students must become computer literate, technologically literate, and scientifically literate, as well as have cultural, environmental, visual, financial, musical, etc. literacy. Thus, when determining appropriate pedagogy, Senge et al. (2000) are in agreement with Gardner when he describes multiple intelligences and that we should strive to teach for all intelligences. Each literacy is a "form of power …and a kind of leverage" (p. 210).

Senge et al. (2000) discuss pedagogy somewhat differently. If "literacy is a form of power," then teaching literacy has inherent power related issues. They present an example in which reading and writing literacy gives individuals power over "the symbolic world of reading and writing," which in turn gives them the power to "affect or transform the world" (p. 211). They present three pedagogical approaches:

- <u>Transmission</u> <u>Pedagogy</u> – takes power away from the learner…and…the teacher;
- <u>Generative</u> <u>Pedagogy</u> – grants teachers and learners the power to relate to the subject matter and build on their knowledge;
- <u>Transformative</u> <u>Pedagogy</u> – provides learners with a functional literacy and provides teachers and learners with a social literacy, or systems literacy, which gives them the power to create their desired future. (p. 211)

When considering what "power" means, we sometimes forget that it can be positive and negative. Its Latin base means "be able"; in French, it means "ability to do things." Therefore, power does not always mean or relate to control and authority. Often people draw on their own power to increase their capabilities. If we move to "<u>em</u>power," there might be an underlying assumption that the receivers have no power other than that given to them and that "the internal powers that drive us as human beings are valid only when granted by external agents who possess knowledge, authority, or control" (p. 211). These authors strive to create awareness that "power from the outside (an individual, group, or organization), especially when unseen and unacknowledged, often disconnects people from their [own] potential power from within" (p. 211). They quote Freire on critical pedagogy. Schools are political sites and no content or process of teaching and learning is politically neutral. "Literacy is best understood as a myriad of [communication] forms and cultural competencies that construct and make available the various relations and experiences that exist between learners and the world" (p. 211).

I have often questioned others on "what" they teach as well as "how" they teach. For example, in history, students often learn about or memorize a chronology of events, e.g. wars. They come away knowing about events and timelines. However, that is not the "content" or "what" they should be learning about. For me, history is all about cause and effect – what caused the wars; what impact the wars had on the people, economy, development, what consequences or outcomes resulted? Onward, what could have prevented the wars; what were the real issues that led to the war? These patterns require thinking at a more critical and analytical level; whereas learning about events and timelines do not. Events and timelines do not lead to literacy, but consideration of critical question and examining underlying causes and effects certainly do. In science, engineering and technology, the same is true. Systems thinking leads us to use methods such as causal loops, which reveal patterns that repeat themselves across contexts or stock and flow diagramming, simulations, modeling software, concept mapping, etc. Memorizing the table of elements does not lead one to understand chemistry, the results of combining elements given particular conditions, constraints, tools, etc. Another example, we can teach students how to use formulas in algebra or physics, but do they understand the individual factors and the relationships between the factors in the formulas, so when they are presented with a problem they can create a formula appropriate for that particular problem. This group also advocates strongly for "learner-centered" learning and "bridging subject boundaries" or integrated interdisciplinary curricula. This is discussed in more detail later, but learner-centered teaching and learning engages the students actively and more authentically in learning and assessment that is as real world related as possible, where the burden of learning or discovery or solution is on the students and not where the teacher "imparts" knowledge. It is usually

problem based; however, it is important to note that not all the answers are known to the problems. Therefore, different students or groups could have different results based upon their strategies of inquiry and development, choice of alternatives, learning styles, problem solving skills, etc.

To affect change in learning, the assumptions about learning must be challenged: 1) schools fix deficiencies, 2) learning takes place in the head rather than the body as a whole, 3) everyone learns in the same way, 4) learning takes place in the classroom rather than the real world, and, 5) there are smart kids and dumb kids. Also we must challenge the assumptions about schools: 1) schools are run by specialists who are in control, 2) knowledge is fragmented, 3) schools reveal the "truth," and 4) learning is individualistic and competition accelerates learning. If we believe the above assumptions, then learning is presented as a machine-like model and process (Senge et al., 2000, pp. 35-50). However, if the model for learning and schools becomes dynamic – a living system where learning focuses on subjects or content as if alive, then the educational processes become "learner centered rather than teacher centered…encourage variety, not homogeneity, embracing multiple intelligences and diverse learning styles; and understanding a world of interdependency and change rather than memorizing facts and striving for right answers" (p. 55). This means that educators are "constantly exploring the theories-in-use of all involved educational process; and reintegrating education within webs of social relationships that link friends, families, and communities" (p. 55).

Ultimately, learning takes place in a community, which ranges from its Indo-European root "everyone" and "exchange" to become "shared by all." It evolved in Latin to mean a "source," in French to mean "to make available to everyone." What is important is that "community" really does not mean a "place" defined by boundaries but by the "sharing of life" (Senge et al., 2000, p. 461). Senge's (2000) group views community to mean

> a group of people or relationships within an organization –as a 'community of practice' or 'learning community' within a school…a community of people is a place rooted in the biosphere, rife with activity, mutual respect, and the recognition that everyone in that place is responsible for and accountable to one another, because the lives of all are interdependent. (p. 461)

Therefore, a community that learns requires three different kinds of activities for a learning approach to develop: defining their identity; building connections; and sustainability – a long-term perspective and an understanding of interdependence (Senge et al., 2000, pp. 461-465). Community has always been critical if learning is to occur very well, as learning is a social process that helps individuals realize their learning potential within a learning community that is supportive, stimulating, relevant, active, and meaningful.

Piaget wrote:

> The principal goal of education is to create people who are capable of doing new things, not simply repeating what other generations have done – people who are creators, inventors, discoverers. The second goal of education is to form minds that are critical, can verify, and do not accept everything they are offered. The

> great danger today is from slogans, collective opinions, and ready-made trends of thought. We have to be able to resist individually, to criticize, and to distinguish between what is proven and what is not. So we need [individuals] who are active, who learn early to find out for themselves, partly by their own spontaneous activity and partly through the materials we set up for them; who learn early to tell what is verifiable and what is simply the first idea to come to them. (as cited in Thomas, Enloe, & Newell, 2005, pp. 41-42)

Boyer (1995) contends that

> …community doesn't just happen…To become a true community, the institution must be organized around people…What we are really talking about is the culture of the school [college]…the vision that is shared, the ways people relate to one another…Simply stated, the school [college] becomes a community for learning when it is a purposeful place, a communicative place, a just place, a disciplined place, a caring place, and a celebrative place. (pp. 17-18)

Directly from a higher education (HE) perspective, Lenning and Ebbers (1999) indicated that learning communities are one of the hottest topics in higher education, and that has continued to be true. They provide three distinct perspectives on learning communities specific to higher education: most common – the curricular approach linking clusters of classes using an interdisciplinary theme, enrolling a common cohort of students. Another perspective exists from the technology arena, where technology provides the vehicle to link students and faculty through the Internet. Finally, internationally, learning communities link people from different countries. Lenning and Ebbers mention Dewey and his principles on the social process of learning (discussed more below). Learning communities today have their roots in cooperative and collaborative learning, where social interaction provides the opportunity for active learning. Lenning and Ebbers feel learning communities use the best principles of student development; therefore, they are focused on the development of student or faculty/student learning communities.

The need for higher education learning communities to improve undergraduate education and to move teaching methodology beyond the lecture approach to large groups of students comes out of the call described above. In higher education, if there is any focus at all, it is on teaching, not student learning. The public cry is to maximize student learning and hold ourselves accountable for improved student learning. The following recommendations are made by the Boyer Commission for Research Universities (1998) but apply equally well for other universities:

1. Make research-based learning the standard;
2. Construct an inquiry-based first year;
3. Build on the freshman foundation;
4. Remove barriers to interdisciplinary education;
5. Link communication skills and coursework;
6. Use information technology creatively;
7. Culminate with a capstone experience;
8. Educate graduate students as apprentice teachers;
9. Change faculty reward systems; and

10. Cultivate a sense of community. (p. 37)

In establishing these standards and the six principles below, the attempt is to reveal a more integrated vision of community, focusing on the quality the students encounter while enrolled in higher education:

1. By a purposeful community, we mean a place where faculty and students share academic goals and work together to strengthen teaching and learning on campus.
2. By an open community, we mean a place where freedom of expression is uncompromisingly defended and where civility is powerfully affirmed.
3. By a just community, we mean a place where the sacredness of each person is honored and where diversity is aggressively pursued.
4. By a disciplined community, we mean a place where individuals accept their obligations to the group and well-defined governance procedures guide behavior for the common good.
5. By a caring community, we mean a place where the well-being of each member is sensitively supported and where service to others is encouraged.
6. By a celebrative community, we mean a place where the heritage of the institution is remembered and where rituals affirming both tradition and changes are widely shared. (Boyer Commission, 1998, p. 6)

This sense of community is "an intentional means to a particular end, which end is to maximize learning of groups and individuals within those groups" (Boyer Commission, 1998, p. 8). A learning community is intentionally developed to promote and maximize learning. Most learning communities share a common feature that of "shared knowledge…The second is shared knowing" (Tinto, 1998, p. 171). It is suggested that they

- Incorporate and value diversity,
- Share a culture,
- Foster internal communication,
- Promote caring, trust, and teamwork,
- Involve maintenance processes and governance structures that encourage participation and sharing of leadership tasks,
- Foster the development of young people, and
- Have links with the outside world. (Gardner, 1989)

Two dimensions of learning communities might be important to higher education. Primary membership differentiates which characteristics group members have in common. Primary form of interaction establishes whether group members have connection capability, direct, in person (physical) interaction, virtual, or other types of correspondence interaction.

Now that we have established that many, if not most, of the universities addressing the development of learning communities are focused on student or faculty-student LCs, Lenning and Ebbers (1999) provide a complete guide to that purposeful end. However,

they do qualify and define categories of learning communities: learning organizations, faculty learning communities, and student learning communities.

- Learning organizations are colleges and universities "consciously structured to promote their own learning and that of their students and faculty members," as contrasted with what has generally been the case – "shared learning experiences" that seem "to promote individual, isolated, passive learning and forms of discourse that are [currently] very much limited to the narrow boundaries of separate disciplines"
- Faculty learning communities are consciously and proactively structured faculty groups organized primarily to promote faculty learning.
- Student learning communities are consciously and proactively structured student groups organized to promote student learning. (Tinto, 1997b, p. 2 as cited in Lenning & Ebbers)

Lewis and Allan (2005) identify types of learning communities as those established to disseminate good practice; to provide the opportunity for innovation and improved practices as well as for international collaboration (in our case, internal, then national, and perhaps internationally), for multi-professional collaboration, and finally, for cross-sector collaboration to improve performance (p. 18). I believe the above goal is also appropriate for our initiative. In addition, Enloe, in Thomas, Enloe, and Newell (2005), itemize a list of principles that they honor in a learning community: 1) excellence and hard work; 2) [positive] attitudes toward learning; 3) respect for diversity; 4) social responsibility; 5) egalitarianism; 6) empathy; 7) development of an ethical self; 8) commitment to an environmental view; and 9) an appreciation of the importance of present (p. 46). Also interesting to consider is their operational framework credited to Quaker beliefs: "our 1) *social* nature results in 2) interactive *relationships*, guided by 3) principles of *democracy*, reflecting 4) *restorative* practices such as 5) the *circle* process" (p. 59). In their discussion about social by nature, they reference Kropotkin (1910), who researched insects, birds, mammals, and humans a century ago. The greater the sociability of a species, the greater its intelligence; the greater its intelligence, the greater its chance for survival. Human socializing, relating, and communicating led to becoming smarter. Kropotkin considers relating and communicating as "being social." Therefore, if we are social in nature, why have we isolated ourselves and students from group learning. As we all know, the sum of the group knowledge and learning is exponentially greater than the sum of individual knowledge and learning. Healthy relationships are basic to content.

Learning occurs at a higher level where good relationships exist. Dewey (1916) established that learning is a social process and that social processes require interaction. Wheatley (1999), on organizational leadership as a new science, wrote that "In the quantum world, relationships are not just interesting; to many physicists, they are all there is to reality" (p. 36). Capra (1996) establishes interdependence and connectedness as

> the basic principles of ecology and use[s] them as guidelines to build sustainable human communities…The first principle he proposes is interdependence….All members of an ecological community are interconnected in a vast and intricate

> network of relationships, the web of life. They derive their essential properties and, in fact, their very existence from their relationships to other things. Interdependence – the mutual…dependence of all life processes on one another--is the nature of all ecological relationships. (pp. 61-62)

Furthermore, all human behavior and failure or success of it is interdependent with that of the others in the community. Therefore, relationships are basic to the content and interaction of community. Capra (1996), Dewey (1916), Wheatley (1999) clearly state that establishing a community value system and democratic processes have great results. Their values for students were reform, project-based learning, accountability, and democracy as a way of life: democracy in the value of the individual and the simultaneous value of community. If a conflict comes into play between the two, remember to recognize the value of both the individual through project-based learning and the value of the group where individuals are members (Dewey). Although their focus for developing the four skills: 1) speaking, 2) listening, 3) making positive decisions for self, and 4) making positive decisions with others was for students, these skills are required of those at any age or generation if they are to be successful. Principles of restorative practice stem from restorative measures in the criminal justice system, where a change

> represents a philosophic shift. For some, this may be a shift from perceiving some students as a problem to actually being able to identify their strengths and potential for success. For others, it may be a change in how behavioral problems are handled. Expanding or beginning restorative measures means getting everyone to agree with the idea of restoration rather than punishment or control models of behavioral management. Restorative measures also mean respecting that all affected parties have the ability to contribution to the solution. Once people are informed and understand the guiding principles, they can begin to think of a myriad of applications. (Minnesota Department of Children, Families and Learning, 1996, n.p.)

Although this was applied to children, it has meaning for us in this initiative. We have perceptions about students, and how we interact with them is critical to their learning, regardless of age. Restorative practices include cooperation, showing respect, being authentic, interacting with the student, speaking with and listening to the student, supporting students' self control and efforts to solve problems, encouraging the use of head and heart, thinking and feeling, focusing on learning, and using group processes. This can be valuable later in our student learning section, but also speaks to how we should treat each other. To them, the circle process entails being open. For us, the circle also represents a closed loop process where feedback provides information for changes, and when that information results in a change, the loop has been appropriately and productively closed by taking action.

Thomas, Enloe and Newell (2005) go on to consider the work by Collay, Dunlap, Enloe, and Gagnon (1998) on <u>learning</u> <u>circles,</u> where the definition of a learning circle is

> small communities of learners among teachers [professors] and others [those external to schools or universities active in communities of practice] who come

> together intentionally for the purpose of supporting each other in the process of learning….[agreeing] that the purpose of life is learning – and that learning is constructivist for all living systems. (p. ix)

Collay et al. (1998) identify six critical conditions for learning communities: 1) building community; 2) constructing knowledge; 3) supporting learners; 4) documenting reflection; 5) assessing expectations; and 6) changing cultures (p. x). These conditions set the process and content to be constructivist. They define "communities of learners as …groups of people gathered together intentionally for the purpose of supporting each other in the process of learning…e.g., college faculty, universities, schools, or districts," business or industry (p. xv). Smaller groups of learners within the larger group or community are learning circles in which there is a "more personal forum for professional interaction and greater opportunity for conversations,…where members can construct ideas together…share opinions….and debate issues" (p. xvi). Learning circles and communities provide a framework where individuals can affect change that results in influencing their organizations. Members have choices, take responsibility, and then work with leaders to set an agenda. These authors identify four factors for professional cultures directly related to student achievement: 1) shared decision making; 2) a shared sense of purpose; 3) collaborative work toward that purpose; and 4) collective responsibility. Learning circles can provide a framework for educators to change their practice, thus influencing the organization within which they perform. They believe that "reform is done to an organization [our college and departments], but organizations don't think or change; individuals do" (p. xvi). Learning circles and communities offer the opportunity for a critical mass to come together to make meaning of an organizational structure or culture, through membership, and then take action, engage in change, to influence the organization. Learning circles make up a broader learning community, but they are a distinct group of people who engage in learning and action together, entering into dialogue, making decisions, trying new ideas or strategies. Learning circles, and possibly the community if it too is within a broader organizational context, do differentiate themselves from the broader community and usually from other types of activities that might be external, yet related, to their endeavors. Their power to support each other is an intrinsic aspect of the social and organizational "fabric." Generally, these circles or communities are informal, although formal structures and organizations can create a context for their work. Their work is based upon similar interests, and they have usually interacted with each other within their professional context.

Figure A.6.2: Community of Learners Schematic

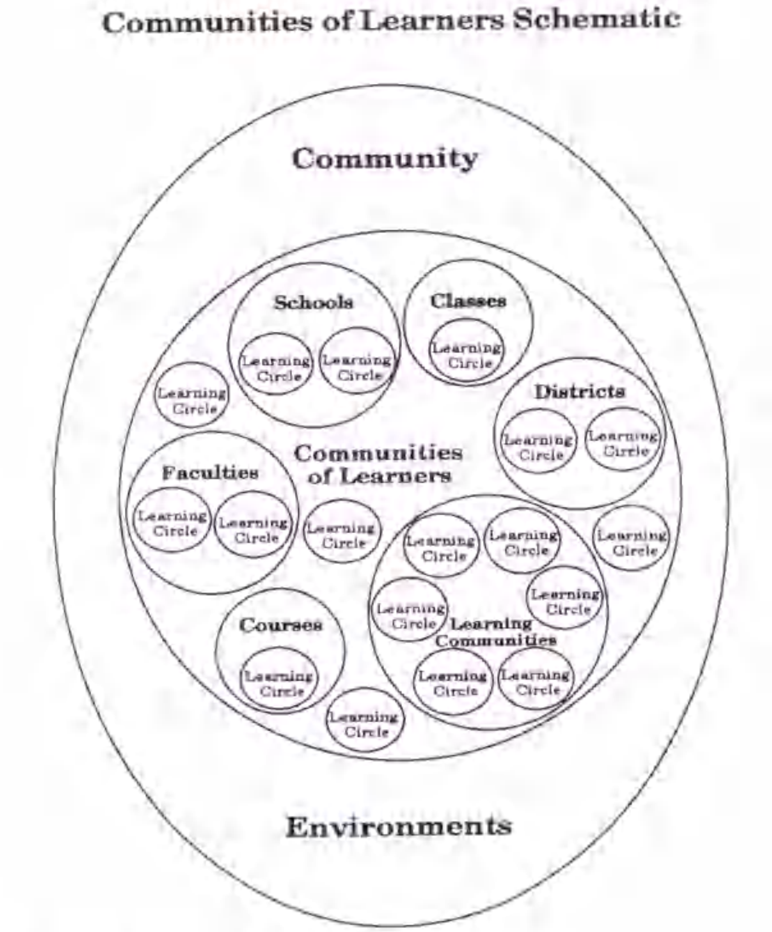


Figure 1.1. Communities of Learners Schematic

(Collay et al., 1998, p. 4)

Collay et al. (1998) provide a good synthesis of theoretical background on learning communities and circles. They believe, in sync with Senge (1990, 1999), that learning is a process of change and that when learning, change occurs. It happens when an individual or group constructs "patterns of action to solve problems of meaning" (Collay et al., p. 3). Humans experience four environmental dimensions: matter, energy, space, and time and then construct patterns of action in each dimension. Those patterns could be across the physical, symbolic, social, and theoretical and take place by "coordinating movements, establishing routines, inventing realities, answering questions, making decisions, setting expectations, creating metaphors, and building theories" (p. 3). Usually perspectives differ across individuals. Collay et al. identified six theoretical strands from which they based their collective thought and theoretical foundation: 1) living organisms; 2) constructivist learning; 3) group process; 4) complex systems; 5) optimal experience; and 6) interdependent networks. The figure below shows the relationships between the theoretical threads and the six essential conditions, also identifying the theorists. We used as a primary guide to our forming and action process.

Table A.6.1: Theoretical Overview

Table 1.1 Theoretical Overview

Theory Strand	*Major Theorists*	*Essential Condition*
Living Organizations	Jean Piaget Aril DeGeus	Building Community
Constructivist Learning	Lev Vygotsky Ernst von Glasersfeld	Constructing Knowledge
Group Process	Pat & Dick Schmuck Phil Runkel	Supporting Learners
Complex Systems	Ludwig von Bertalanffy Charles Perrow	Documenting Reflection
Optimal Experience	Mihaly Csikszentmihalyi David Bohm	Assessing Expectations
Interdependent Networks	Robert Kegan Fritjof Capra	Changing Cultures

(Collay et al., 1998, p. 6)

Although many of the sources on learning communities focus on their development at the K-12 level, this does not mean that their strategies, designs, processes, techniques and methods do not apply to the post secondary level. Seemingly, K-12 has engaged in change that also applies to higher education, and in my humble opinion, this often happens when higher education should have been leading the design or development of educational change in partnership with K-12 or should have been doing the initial research and then leading K-12 to do so.

Wilson and Ryder (1996) define dynamic learning communities as communities in which "members share control and everyone learns, including the facilitator or tutor or group leader. Transformative communication is the norm, with both sender and receiver of messages changed by the interaction…all participants are engaged in the learning experience" (p. 11). Lewis and Allan (2005) define a learning community as "a supportive group of people who come together to collaborate and learn together; they are usually facilitated or guided to achieve a specific outcome or agreed learning objectives" (p. 8). They discuss "transformative" learning communities as those that enable "like-minded people or colleagues or professionals with a common or multi-professional interest to work together and to achieve a particular aim or organizational objective" (p. 6). They go on to characterize learning communities as where there is

- a shared goal, problem or project;
- shared resources;
- shared membership and leadership;
- commitment to improvement of professional practice;
- collaborative approaches to group work;
- learning and development focused on real work-based issues and practice;

- autonomous community members;
- high levels of dialogue, interaction and collaboration;
- information and knowledge sharing;
- knowledge constructivism;
- knowledge transfer and knowledge exchange;
- use of information and communication technologies. (pp. 6-7)

Learning communities may exist within organizations to engage and empower a creative group of colleagues with "complementary set of knowledge, skills and attitudes to produce dynamic approaches to problem solving, knowledge management and knowledge creation" (Lewis & Allan, 2005, p. 6). Often, as with our initiative, there is a structured program of study. With others, as also with our initiative, communities are established to manage change and deal with any related issues pro-actively. A program of learning and/or training may be characterized as:

- pre-planned with pre-determined aims and learning outcomes;
- program is often owned by an education or training group (not true for ours; we have developed our own)
- programs are facilitated by a tutor or trainer who has a responsibility for curriculum content and ensuring that the program follows its pre-determined course, including a set range of activities or tasks;
- clear start and end date;
- differential in power between the learner and the tutor/trainer;
- programs are often accredited, for example by higher education institutions or professional bodies;
- the learner is sometimes viewed as the 'customer' who consumes the learning. (p. 5)

Some of these characteristics fit our initiative and some do not. We do have pre-determined aims and outcomes; there is a facilitator for which some power distance is true; there is a clear start and end date; and the learners are our own faculty members. Some of the characteristics above better describe the relationship that might occur between K-12 schools and higher education (Lewis & Allan, 2005). Therefore, our learning community is meeting the criteria identified here as well as other criteria to be mentioned below and will engage in a program of learning and experimentation on teaching and learning.

Important to any learning community discussion is the community of practice (CP) within which it exists. Characteristics of a community of practice (professional real world groups or organizations within which groups engage) are

- common purpose identified by participants;
- shared membership and leadership;
- participants likely to be at different stages in their professional life;
- development of professional practice through apprenticeship;
- acceptance of low levels of participation by new members, that is, legitimate peripheral participation;

- development, creation and management of knowledge within organizations;
- open-ended, not time bound;
- importance of dialogue, interaction and shared narratives. (Lewis & Allan, 2005, p. 7)

To follow our logic, it is important to understand another community, that of community of interest. These involve larger groups of people, perhaps a network or larger body. They may support the dissemination and exchange of information but probably are not directly supportive of the collaborative learning processes that occur between members of the LPs or LCs. An example of a CI is those members of the National Association of Industrial Technology; the American Society of Engineering Educators; those involved in the discipline specific organizations such as Plastics Engineering, the Society of Manufacturing Engineers, etc.; and groups of members who cluster together around specific, but common or related, interests. In my opinion, a community of interest to our initiative would be the broader university community within which we are organized as a college of four departments. The Table below presents a comparison succinctly:

Figure A.6.3: Learning Community Relationships

Figure 1.1 Relationships between learning programmes, learning communities and communities of practice
(Lewis & Allan, 2005, p. 8)

Table A.6.2: Comparison of Learning Communities

Table 1.1 Comparison of learning communities and communities of interest

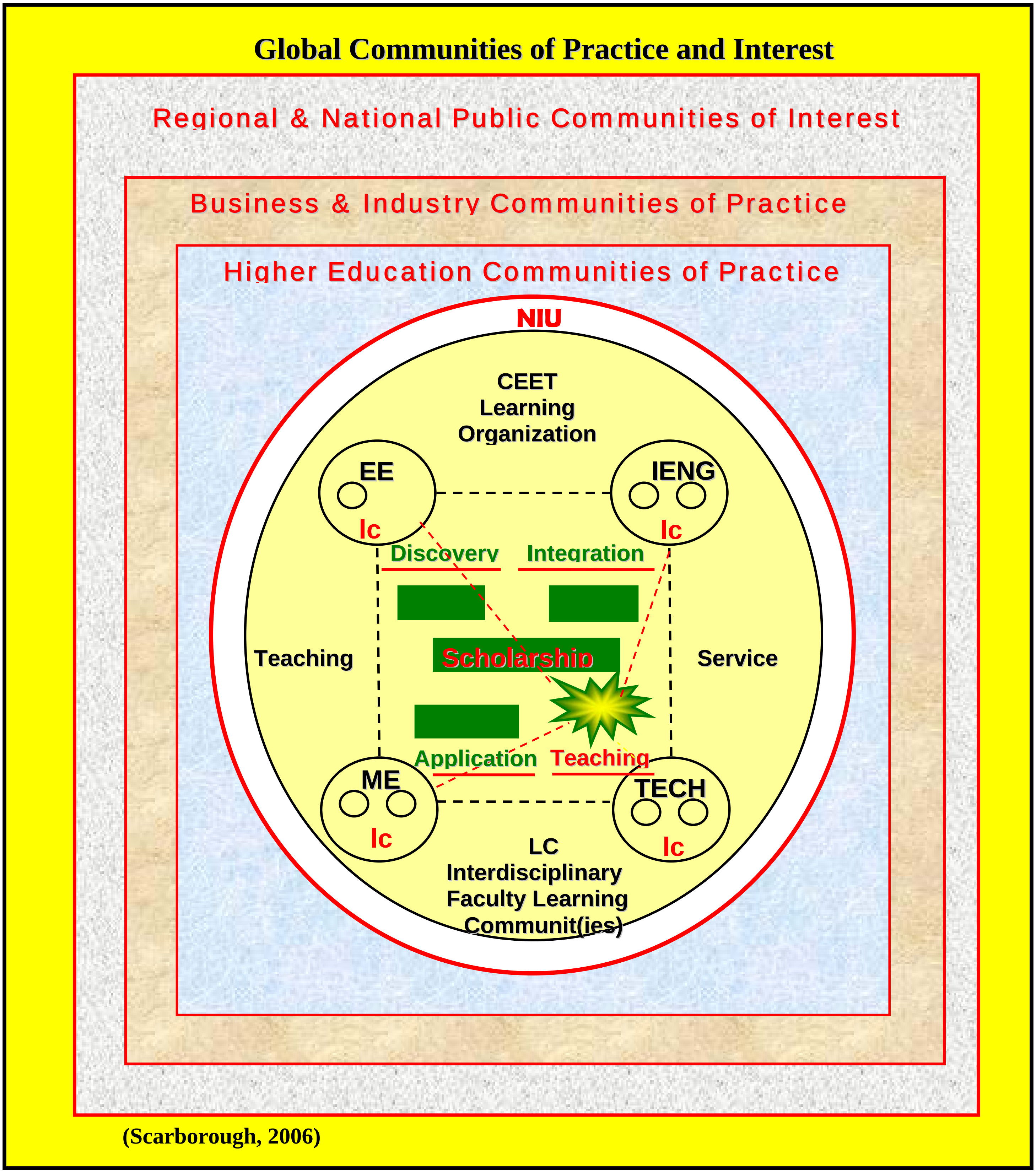
Characteristics	*Learning communities*	*Community of interest*
Purpose	To problem solve To improve professional practice To improve the effectiveness of an organization or project To create and expand knowledge	To be informed To share ideas and information To meet up with like-minded people
Membership	People who share a particular interest or passion in a topic People who volunteer or are invited to become a member This may be self-selected or by invitation Membership is likely to be relatively small, e.g. 6–24	Open to people who share a particular interest This is likely to be self-selected People who become subscribers or members of a particular group, e.g. mail list, e-learning programme Membership may be very large, e.g. 12–1000
What holds them together	Passion, commitment, identity with group Personal relationships within the group	Access to information and sense of like-mindedness
Examples	Some groups involved in collaborative project work Professional groups supported by professional organizations Some e-learning programmes	Some discussion groups Newsgroups

(Lewis & Allan, 2005, p. 9)

Lewis and Allan's (2005) figure implies an overlap or integration between the learning community, community of practice, and learning program. Figure 1.1 and Table 1.1 indicates that they seem to use the terms “interest” and “practice” interchangeably. The CEET model acknowledges the integration or overlap, but in a different way. Our model reveals more of a nesting relationship between entities. There is a clear relationship between the four Scholarships identified by Boyer (1990); and, the Scholarship of Teaching is a manifestation of each of the other models as well as a type of research on its own merit. The research context is one of learning for we acknowledge the College of Engineering and Engineering Technology as a formal Learning Organization (Senge, 1990). The faculty LC for this initiative is a smaller learning organization, but a formal one, within the college framework. we hope other LCs evolve within the college context, the LC is interdisciplinary and exists outside the formal departments; however, the model acknowledges the relationships between the four departments. It was our hope to engage

four “learning circles”, one from each department, and that did occur for three departments. However, one department lost a member, therefore, there was only one individual from that particular department. We prefer the model of departmental learning circles that then make up the interdicsiplinary college Learning Communities of faculty members. The college exists within the university and the community of practice of all universities. It also exists within the “real-world” context of the disciplinary communities of practice, business and industry. Yet, broader than those, are the communities of interests, e.g. State of Illinois and its Citizens Agenda for state universities. And finally, we must acknowledge the broader global communities of both practice and interest. Of course, we agree with Lewis and Allan that everything overlaps and is integrated, but we also want to reflect the nesting of one environment within another. That is also why our faculty development program was designed as an integrated program, rather than a separated set or series of workshops; also, that is why it began with building a foundation and extended to include implementation and research AS an INTEGRAL ASPECT of the program design. The CEET Model:

Figure A.6.4: CEET Learning Community Model-Northern Illinois University



Furthermore, Lewis and Allan (2005) educate us about virtual learning communities (VLC). These can be powerful because they can release us from the geographic, cultural, and demographic constraints of the thoughts, practices, considerations, and actions. They identify why there is a rise in virtual learning communities beyond technological advancements:

- intensifying competition and globalization ;
- new ways of working, for example collaborative partnerships;
- accelerating change and the need to manage change and problem solve;
- information explosion and the rise of knowledge management;
- developing and converging communication and information technologies;
- need for continuous professional development. (p. 11)

Virtual LCs allow us to work together, support each other, and work when it suits our time, so we can maintain some level of work-life balance. Important to note is

> The information explosion continues in size, complexity and diversity. Information overload is a recognized stress stimulus and our business is in managing, organizing and enabling the exploitation of information, so that we have control and contain the explosion on behalf of organizations and individuals who need or demand not overload but filtered, validated and authoritative information. (Lewis & Allan, 2005, p. 12)

Although, we are not a virtual community, we did try to contain the information overload of our participating faculty members by doing tasks one time for all – for example, this learning document. It was our intent to eliminate redundant activity, make things as simple but illuminating as possible in designing and developing the foundation for learning and action. We established existing knowledge, explored the views, theories, and thoughts of others to build or extend "explicit" knowledge, and then acted upon that knowledge through research with students, also extending "tacit" knowledge. Tacit knowledge is built through personal experience, whereas explicit knowledge can be codified and explained. Learning communities engage in the key activity of

> transforming tacit into explicit knowledge [by]…explor[ing] experience and practice, interrogat[ing] new ideas, concepts and evidence, discuss[ing] personal perspectives and concerns with fellow professionals…interactions often result in the development of clarity and a shared language…LCs provide a vehicle whereby new members…are able to tap into the tacit and explicit knowledge of experienced practitioners. (Lewis & Allan, 2005, pp. 12-13)

This can occur whether a VLC or not. Managing knowledge can take place through three approaches: 1) databases and repositories; 2) knowledge route maps and directors; and 3) knowledge communities and networks. Technology as it is defined above is "the science of efficient action that extends human potential and capacity"; thus “individual and collective power, ultimately transforming society and our world” provides the technological capability of creating LCs across the world because now we can communicate, if careful, quite effectively ((Lewis & Allan, 2005, p. 14). Although Lewis and Allan focus on virtual learning communities, the lists of benefits of belonging to a

VLC and benefits to one's continuing professional development (CPD) also apply to our initiative

Figure A.6.5: Benefits Checklist – Virtual Learning Communities

Box 1.2 Checklist of benefits of virtual learning communities to support CPD activity

- Encourages professional knowledge sharing and knowledge management
- Helps specialists assigned to individual project teams connect with specialists in other organizations in other geographical locations
- Encourages multi-professional working
- Virtual place to discuss issues related to effective daily practices; improved productivity and services; and enables community members to work more efficiently at lower cost
- Encourages cross-sector collaboration
- Online discussions automatically recorded and evidenced
- Experts can be brought in to give inputs on specific themes
- Provides flexibility in time, pace and place
- Opportunities for acquiring new knowledge
- Gives practitioners more effective ways to address problems or current issues
- Challenges people to be more creative
- Promotes leadership and peer support
- Collaborative activities promote new techniques

(Lewis & Allan, 2005, p. 17)

Figure A.6.6: Benefits Checklist – Organizations

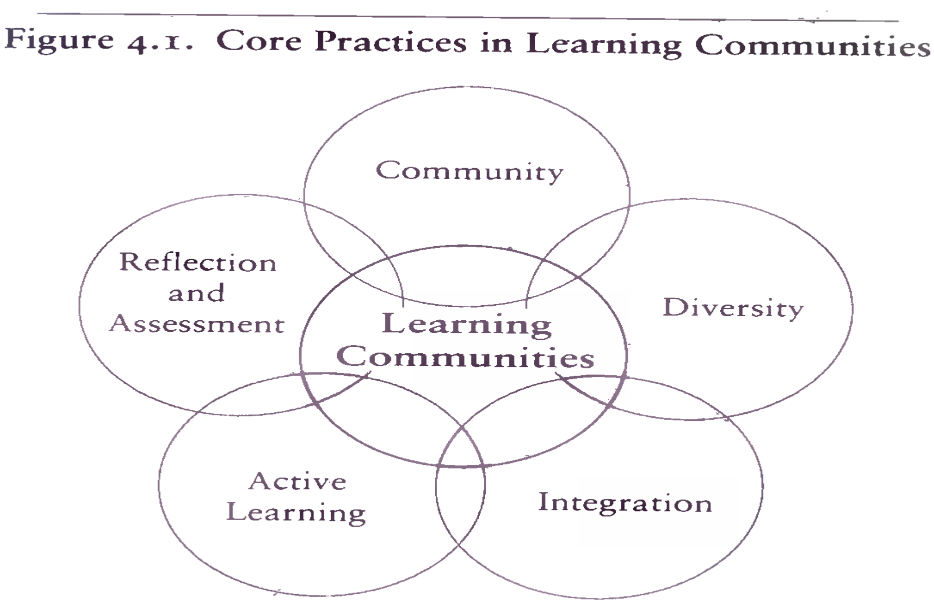
Box 1.3 Checklist of benefits for organizations

- Shared information and expertise
- Team building
- Knowledge management
- Development of good practice
- Empowered to challenge accepted institutional assumptions
- Opportunity to find innovative solutions to complex problems
- Enhanced sense of identity and group membership
- Effective working across traditional departmental boundaries
- Improved communication
- More highly motivated staff
- Positive impact on staff morale
- Develops a culture of change and innovation
- Dynamic problem solving and 'out-of-the-box' solutions
- Development of learning organizational practices
- Continuing professional development of those involved
- Increased productivity
- Increased levels of practitioner competence
- Service improvements

(Lewis & Allan, 2005, p. 18)

Although Smith, MacGregor, Matthews and Gabelnick (2004) focus on student learning communities, they offer core practices for learning communities for which the challenge is to "take advantage of the learning community structure to capture and intensify the synergistic possibilities for meaningful community building and learning…spaces to bring together the theory and practice of student [faculty] development and diversity, of active inclusive pedagogies, and of reflective assessment" (p. 97). They recommend that all LCs be implemented with these core practices in mind: community, diversity, integration, active learning, and reflection/assessment.

Figure A.6.7: Core Practices



(Smith et al., 2004, p. 98)

Their model is based upon <u>inclusion,</u> where learners feel a sense of belonging and connectedness, both academically and socially. Faculty teaching teams are one way to enhance this for both students and faculty members, establishing relationships between courses, in-class and external activities, general education and major components of the program, informal social occasions, study groups, and service learning projects. An example of service learning in one of our classes is where student teams are expected to seek out a service project in the community that requires leadership and use of their collective knowledge and skills, provides a service, and inherently helps prepare them to become a formal team. This works for the course content, engages students in getting to know each other, helps them to realize that corporations expect them to provide community leadership, and so much more. Service learning, although not a new concept, is a renewed practice and can be a very effective teaching method, serving for knowledge gain as well. <u>Collaboration and interdependence</u> occur when learners <u>learn in community</u> or engage in collaborative work to make meaning, debate issues, solve problems, create products, or engage in other learning tasks. They have to practice and become more

skilled at articulation, listen to others, consider other ideas than their own, contribute to and negotiate (work through) constructive disagreements or conflicts – learn to work together, a vital skill today! There will be challenges. However, this is required for one active in a community of practice as discussed above, where knowledge sharing occurs for a result of growth. Learners are diverse in background (e.g., educational preparation and experience, practical or work experience, personalities, work styles, information processing styles, culture, socio-economically, politically, and in so many more ways) whether faculty or students. Diversity lends itself to more significant results as long as participation by all is the practice.

Most important is ways of knowing (and learning). If the instructional leader is analytical and focuses more in intellectual concepts while their learners favor experiential or relational forms of learning, there may be a conflict. The Association of American Colleges (1982) found that direct lecture-centered courses were not as successful with women. Belenky, Clinchy, Goldberger, and Tarule (1986) provide an influential book on women and their ways of knowing: women prefer more connected ways of learning with more dialogue where life experiences are part of the process and where they can find their voices and feel validated through connections with new knowledge and understanding. More has been done since this work on Latinos and African-American students (Tierney, Coylar, & Corwin, 2003).

Integration is a model component meaning "continually blend[ing] the old and the new…We construct our understanding using part of what we already know and part of what is new" (Zull, 2002, p. 119). Deep learning occurs best when creating structures and opportunities to stimulate connection making, extending one's schema or framework of knowledge, and providing opportunities to change it with new knowledge or a combination of the old and new. We can add new or change the old by combining it with the new.

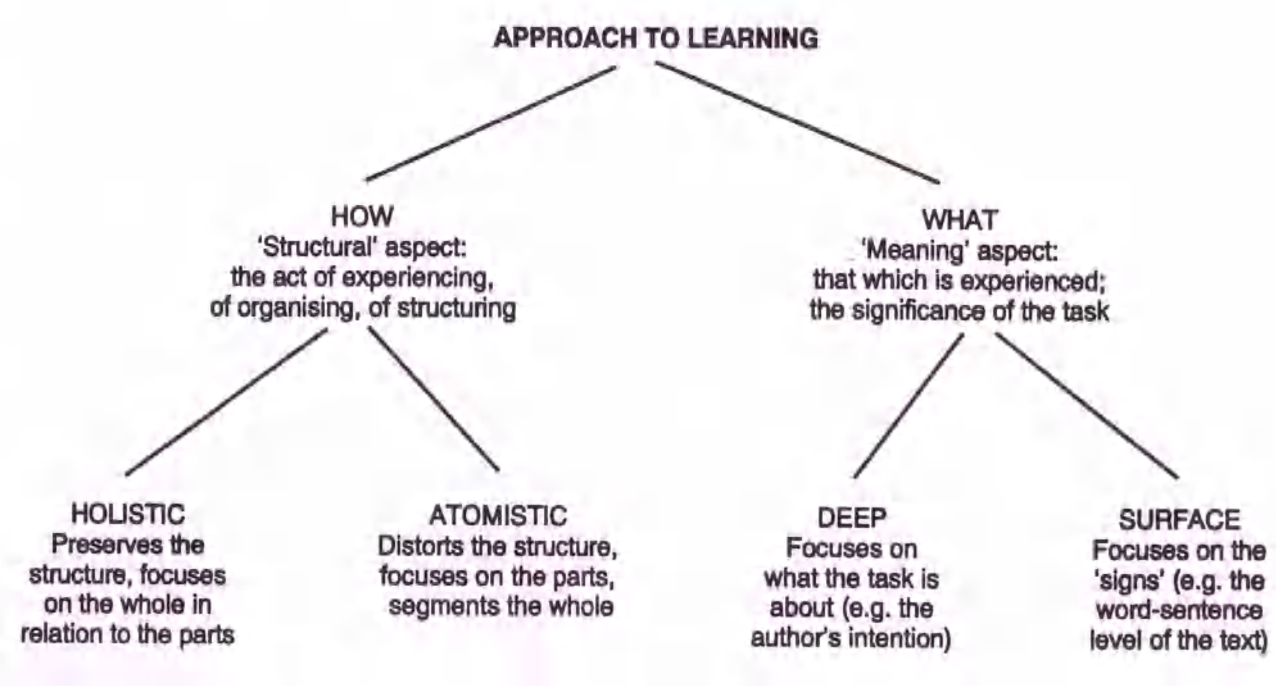
- Surface learning refers to short term memory and the information embedded in the short term memory; surface learning is usually not internalized to become part of one's knowledge structure, or schema.
- Deep learning is that which is more permanently embedded in one's evolving understanding of a subject; it transforms the learner in some way. These can provide an orientation to learning (e.g., memorizing and reproducing from recall versus where one makes more personal meaning by transforming information and ideas in relation to what they already know – their knowledge and experience) (Entwistle, 2000, p. 10; Marton as cited in Ramsden, 1992).
- Active learning, another component of the model, or the constructive process, occurs when learners engage in an experiential process that allows for the attaching of new knowledge to what one already knows, making and remaking one's meaning or understanding. With new knowledge, an old bit or understanding changes into something new. Knowledge is forever changed if it goes beyond the "incorporation of inert ideas merely received into the mind without being utilized, or tested, or thrown into fresh combinations" (Whitehead, 1929/1949, p. 13) and promoting active learning where

> learning is not a spectator sport. Students [faculty] do not learn much just by sitting in class listening to teachers, memorizing prepackaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences, apply it to their daily lives. They must make what they learn part of themselves. (Chickering & Gamson, 1987, p. 3)

- Finally, the last component for an LC is <u>reflection and assessment</u>, where assessment occurs as learning. This will be discussed in more depth later, but presently let us say that it requires learners to reflect upon their work and consider what matters, where they began, where they are, and what is still to be accomplished. In further considering reflection and assessment, it can occur in three ways: assessment as learning, reflection as learning, and communities of reflection.

  - <u>Assessment as learning</u> improves work over time, "a process integral to learning that involves observation and judgment of each student's [professor's] performance on the basis of explicit criteria with resulting feedback" (Alverno College Faculty, 1994, p. 3). The focus is learning, and the developmental improvement of that learning is the center of the assessment practice. Work is compared against criteria, expectations, or standards.
  - <u>Reflection as learning</u> is where students are asked to examine their own prior knowledge and assumptions explicitly and pay attention to how the new learning is changing those assumptions, understandings, or meanings. Students identify where they are making new connections/meanings, or where their understandings have changed.
  - <u>Communities reflection</u> is where collaborative learning has taken place and where the group reflects together, processing as a collective, extending their understandings and meanings to include those of others; then may, again, change their own. When looking back, integration and closure to the academic and social learning experience has been achieved.

Figure A.6.8: The Logical Structure of Approaches to Learning



(Marton as cited in Ramsden, 1992)

Table A.6.3: Different Approaches to Learning

Deep approach

Intention to understand. Student maintains structure of task.

Focus on 'what is signified' (e.g. the author's argument, or the concepts applicable to solving the problem).
Relate previous knowledge to new knowledge.
Relate knowledge from different courses.
Relate theoretical ideas to everyday experience.
Relate and distinguish evidence and argument.
Organise and structure content into a coherent whole.
Internal emphasis: 'A window through which aspects of reality become visible, and more intelligible' (Entwistle and Marton, 1984).

Surface approach

Intention only to complete task requirements.
Student distorts structure of task.

Focus on 'the signs' (e.g. the words and sentences of the text, or unthinkingly on the formula needed to solve the problem).
Focus on unrelated parts of the task.
Memorise information for assessments.
Associate facts and concepts unreflectively.
Fail to distinguish principles from examples.
Treat the task as an external imposition.
External emphasis: demands of assessments, knowledge cut off from everyday reality.

(Ramsden, 1992, p. 46)

Table A.6.4: Examples of Questions in the Lancaster Approaches to Studying and the Biggs Study Process Questionnaires

Orientation to studying (General approach to learning)	*Indicative items*
Meaning orientation (Deep approach)	• I try to relate ideas in one subject to those in others, whenever possible. • I usually set out to understand thoroughly the meaning of what I am asked to read. • In trying to understand new ideas, I often try to relate them to real-life situations to which they might apply. • When I'm tackling a new topic, I often ask myself questions about it which the new information should answer. • In reading new material I often find that I'm continually reminded of material I already know and see the latter in a new light. • I spend a lot of my free time finding out more about interesting topics which have been discussed in classes.
Reproducing orientation (Surface approach)	• I find I have to concentrate on memorising a good deal of what we have to learn. • I usually don't have time to think about the implications of what I have read. • Although I generally remember facts and details, I find it difficult to fit them together into an overall picture. • I find I tend to remember things best if I concentrate on the order in which the lecturer presented them. • I tend to choose subjects with a lot of factual content rather than theoretical kinds of subjects. • I find it best to accept the statements and ideas of my lecturers and question them only under special circumstances.

(Ramsden, 1992, p. 52)

Dufour and Eaker (1998), although discussing LCs in schools, do inform us about process and content. They begin with statements from Covey (1996) and others. Here are a few they value: "Only the organizations that have a passion for learning will have an enduring influence" (p. 149). And Drucker (1992) "Every enterprise has to become a learning organization. Organizations that build in continuous learning in jobs will dominate the twenty-first century" (p. 109). These comments certainly apply to higher

education and schools as well. Also "If schools want to enhance their organizational capacity to boost student learning, they should work on building a professional community that is characterized by shared purpose, collaborative activity, and collective responsibility among staff" (Newmann & Wehlage, 1995, p. 37). And finally, "The new problem of change…is what would it take to make the educational system a learning organization – expert at dealing with change as a normal part of its work, not just in relation to the latest policy, but as a way of life" (Fullan, 1993, p. l4).

In beginning with the end in mind as Covey (1996) suggests, Dufour and Eaker (1998) define what an LC looks like:

1. shared mission, vision, and values;
2. collective inquiry where the "team learning wheel" is
   - public reflection,
   - shared meaning
   - joint planning
   - coordinated action;
3. collaborative teams;
4. action orientation and experimentation;
5. continuous improvement where the key questions are: 'What is our fundamental purpose? What do we hope to achieve? What are our strategies for becoming better? And what criteria will we use to assess our improvement effort?; and,
6. results orientation where the results are assessed based upon results rather than intentions. (pp. 26-29)

Dufour and Eaker (1998) model the corporation model and value the strategies of corporate leaders. They go further to suggest four building blocks of a professional LC:

- <u>Mission:</u> Why do we exist? Everybody can learn based on their ability if they take advantage of the opportunity to learn, and we will accept responsibility for ensuring their growth and establish high standards of learning that we expect all students to achieve.
- <u>Vision</u>: What do we hope to become?
- <u>Values</u>: How must we behave in order to make our shared vision a reality?
- <u>Goals:</u> Which steps will we take first, and when? (pp. 60-62)

Dufour and Eaker (1998) suggest that sustainability be addressed by auditing the effectiveness of the LC and identifying significant factors to monitor and assess. They consider critical questions a good process and the timing of the assessment strategy and make a good point that "Collaboration by Invitation Does Not Work" (p. 118). The isolation of teachers, for them, and professors, true for us, is so ingrained that invitations for collaboration may not result in action; therefore, "to build professional learning communities, meaningful collaboration must be systematically embedded into the daily life of the school" (p. 118). Although they are speaking of K-12 situations and we are at the university level, this too has a lesson for us because professors are even more isolated and independent than K-12 teachers. Therefore, collaboration has to be designed and embedded in a different way, and we cannot assume that it will take place without a

structure, leader, definite timeline, goals, objectives, activities, assessment, and evaluation, followed by the continuous cycle of plan, act, do, and check (Deming, 1956) with fully engaged leadership. Therefore, the time for collaboration must be clear and built into the schedule; the purpose and expected outcomes must be explicit; professional development must be mandatory for participants; and professionalism as a value must be exhibited through responsible action with accountability for results.

We are seeking a culture change. One that involves the following transformation:

Serendipity	→	Intentional
Individual	→	Group
Isolation	→	Collaboration
Disciplinary	→	Interdisciplinary
Autonomous	→	Democratic
Nebulously defined performance	→	Criterion referenced or defined performance
Results are not defined	→	Results oriented

Double Loop Learning

Argyris (1976; Smith, 2001) proposed the double loop learning theory, where the change relates to the change in underlying values and assumptions, lending its use to more complex and ill-structured problem solving that changes as the problem solving advances. It is based on a "theory of action," where there is a distinction between an individual's "espoused theory" and his/her "theory in use" or what they do. Double loop learning brings the two, one's "espoused theory" and "theory in action," together. In other words, there is a "split between theory and action" or what we do as practitioners and how we speak of our actions to others (theories in use). The words we use to explain what we do or to tell others what we think we do are "espoused theory." So is there a match between intention and outcome? If there is a mismatch between the two, then there is conflict. Usually, there would need to be interaction with others to discover a conflict between what one espouses and what one does. There are two responses to the mismatches or conflicts between what people say they are doing and what they actually do. The first response could be that when something goes wrong, people will simply look for another strategy that will work within the governing variables. An alternative response, however, could result, which would mean that rather than merely selecting another strategy, someone would actually challenge the governing variables and try to shift the way in which strategies and consequences are framed; this is double loop learning. A good example occurs

> when the error detected and corrected permits the organization [or person] to carry on its present policies or achieve its present objectives, then that error-and-correction process is single loop learning. Single-loop learning is like a thermostat that learns when it is too hot or too cold and turns the heat on or off. The thermostat can perform this task because it can receive information (the temperature of the room) and take corrective action. Double loop learning occurs when the error is detected and corrected in ways that involve the modifications of an organization's [or person's] underlying norms, policies, and objectives. (Argyris & Schon, 1974, pp. 4-30)

The basic steps in this action theory learning process are

1. discovery of espoused and theory-in-use
2. invention of new meanings
3. production of new actions
4. generalization of results

The double-looped learning theory involves an individual in applying each step to itself (the theory), where underlying assumptions or current viewpoints are questioned by following through to testing hypotheses about behavior publicly. This should increase effectiveness in decision-making. An improved acceptance of failures and mistakes should also follow as a result of using the four steps. The double loop learning theory is a "personal change" theory and is oriented toward professional education. A great example for our professional development of professors follows from Argyris (1976):

> A teacher who believes that she has a class of 'stupid' students will communicate expectations such that the children behave stupidly. She confirms her theory by asking them questions and eliciting stupid answers or puts them in situations where they behave stupidly. The theory-in-use is self-fulfilling. Similarly, a manager who believes his subordinates are passive, dependent and require authoritarian guidance rewards dependent and submissive behavior. He tests his theory by posing challenges for employees and eliciting dependent outcomes. In order to break this congruency, the teacher or manager would need to engage in open loop learning in which they deliberately disconfirm their theory-in-use. (p. 16)

Argysis (1993) and Schon and Argyris (1996) have moved on further to evolve the theory, focusing on the development of action theory more broadly, "action-science"; this also impacts learning at the organizational level. The original and more evolved theories apply to our situation, as we are striving to have professors examine and challenge their current values and assumptions within their current schema (mental framework or map – discussed within) while also challenging a broader learning by the college as an organization. The operational principles for double loop learning are

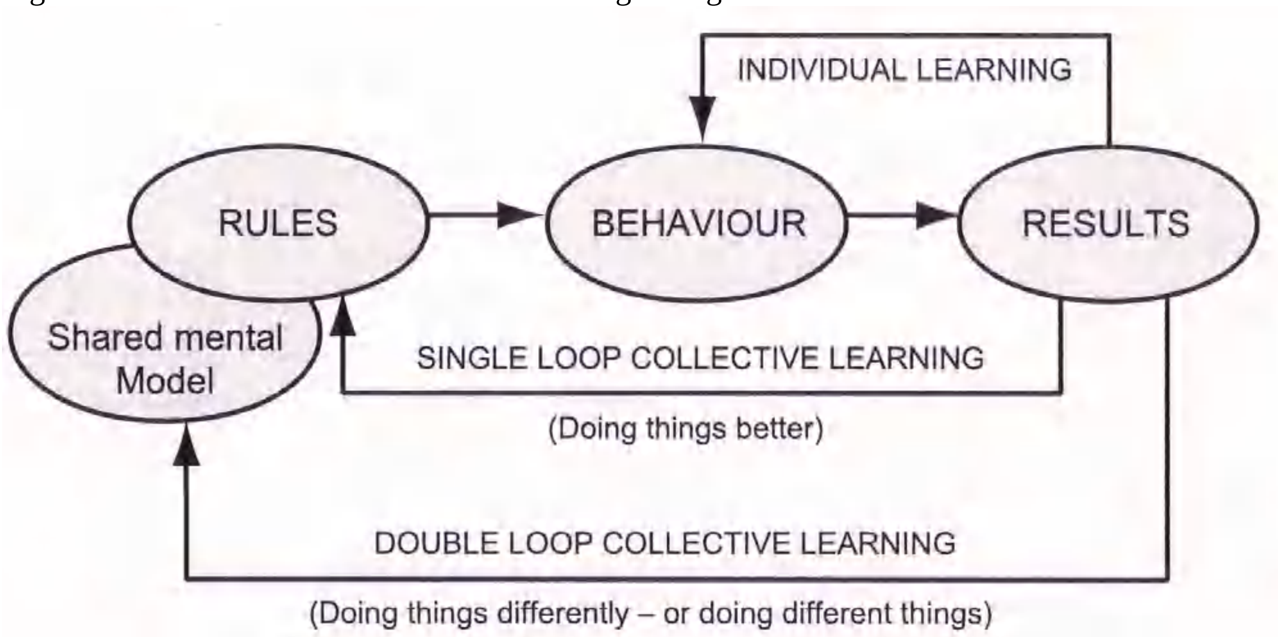
1. Effective problem-solving about interpersonal or technical issues requires frequent public testing of theories-in-use.
2. Double loop learning requires learning situations in which participants can examine and experiment with their theories of action. (p. 1)

Argyris and Schon (1974) present the initial model with three variables (original terms):

- <u>Governing variables (Rules)</u>: those dimensions that people are trying to keep within acceptable limits. Any action is likely to impact upon a number of such variables; thus any situation can trigger a trade-off among governing variables.
- <u>Action strategies (Behaviours)</u>: the moves and plans used by people to keep their governing values within the acceptable range.
- <u>Consequences (Results)</u>: what happens as a result of an action. These can be both intended – those actors believe will result – and unintended. In addition, those consequences can be for the self and/or for others. (Anderson, 1977)

The work of Argyris and his colleagues set the theoretical stage for the work of Senge and others on learning, individually and organizationally.

Figure A.6.9: Individual and Collective Learning in Organizations



Adapted from Swieringa & Wierdsma (1992)

How People Learn was produced as the final product of a study to determine "how better to link the research on the science of learning to actual practice in the classroom" (The National Research Council (NRC), 2000 p. vii). The researchers focused on human learning, learning research, and how to help all individuals realize their potential. Although this report may often appear to be K-12 focused, it is equally focused and meaningful for adult and professional development learning. The key findings, which are also supported by research, are

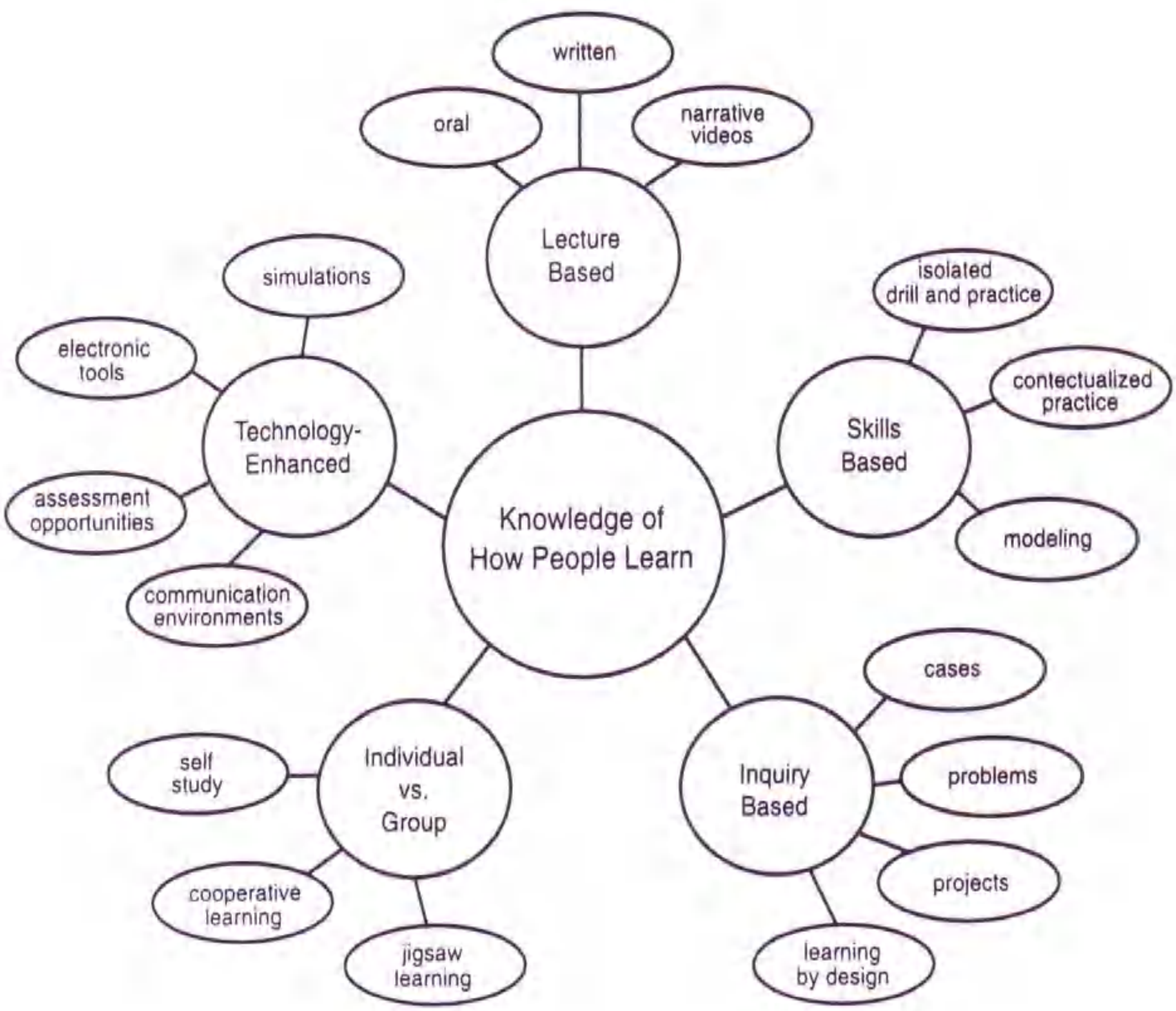
1. Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test but revert to their preconceptions outside the classroom.
2. To develop competence in an area of inquiry, students must (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.
3. A metacognitive approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them. (pp. 14-18)

The implications for teaching are profound:

- Teachers must draw out and work with the preexisting understandings that students bring with them - replacing the model of the student as an empty vessel…requiring the expansion of roles for assessment beyond traditional testing.

- Teachers must teach some subject matter in depth, providing many examples in which the same concept is at work and providing a firm foundation of factual knowledge, replacing superficial coverage with deeper coverage [where] teachers have in-depth knowledge of the subject matter themselves
- The teaching of metacognitive skills should be integrated into the curriculum of a variety of subject areas…metacognition often teaches the form of an internal dialogue…students may be unaware of its importance unless teachers explicitly emphasize it…[requiring] the integration of metacognitive instruction with discipline-based learning [and the development] of strong metacognitive strategies [embedded in the curriculum]. (NRC, pp. 19-21)

Figure A.6.10: With Knowledge of How People Learn, Teachers Can Choose More Purposefully Among Techniques to Accomplish Specific Goals.



(National Research Council, 2000)

Therefore, in the design of learning environments:

- Classrooms must be learner centered.
- Attention must be given to what is taught (information, subject matter), why it is taught (understanding), and what competence or mastery looks like. Learning with understanding is harder to accomplish…Many curricula present too many disconnected facts in too short a time…[K]nowledge-centered environment provides [opportunity] for depth of study.
- Formative assessments, ongoing assessments designed to make students' thinking visible to both teachers and students are essential. They permit the teacher to grasp the students' preconceptions, understand where the students are in the developmental corridor from informal to formal thinking, and design instruction accordingly. In the assessment-centered classroom environment, formative assessments help both teachers and students monitor progress.
- Learning is influenced in fundamental ways by the context in which it takes place. A community-centered approach requires the development of norms for the classroom and school as well as connections to the outside world that support core learning values…[meaning] norms such as "risk-taking" or "don't get caught not knowing something"…designing classrooms and activities in ways that promote the kind of intellectual camaraderie and attitudes towards learning that build a sense of community…establishing a community of learners. (NRC , 2000)

They present a critique of both child, adult, and professional development learning frameworks. They

- are not learner centered
- are not knowledge centered
- are not assessment centered
- are not community centered

(NRC, 2000, pp. 23-27)

In thinking further about learners and learning, the NRC (2000) distinguished experts from novices and then how the processes of learning develop expertise in a learner. By understanding expertise, we can better understand the nature of thinking and problem solving. Expertise is not just memory or intelligence, not abilities, but rather an extensive level of knowledge that affects everything about how they learn, how they organize, represent, and interpret information in their environment. This affects remembering, reasoning, and problem solving. They hold the following key principles to be true:

1. Experts notice features and meaningful patterns of information that are not noticed by novices.
2. Experts have acquired a great deal of content knowledge that is organized in ways that reflect a deep understanding of their subject matter.
3. Experts' knowledge cannot be reduced to sets of isolated facts or propositions but instead reflects contexts of applicability: that is, the knowledge is "conditionalized" on a set of circumstances.
4. Experts are able to flexibly retrieve important aspects of their knowledge

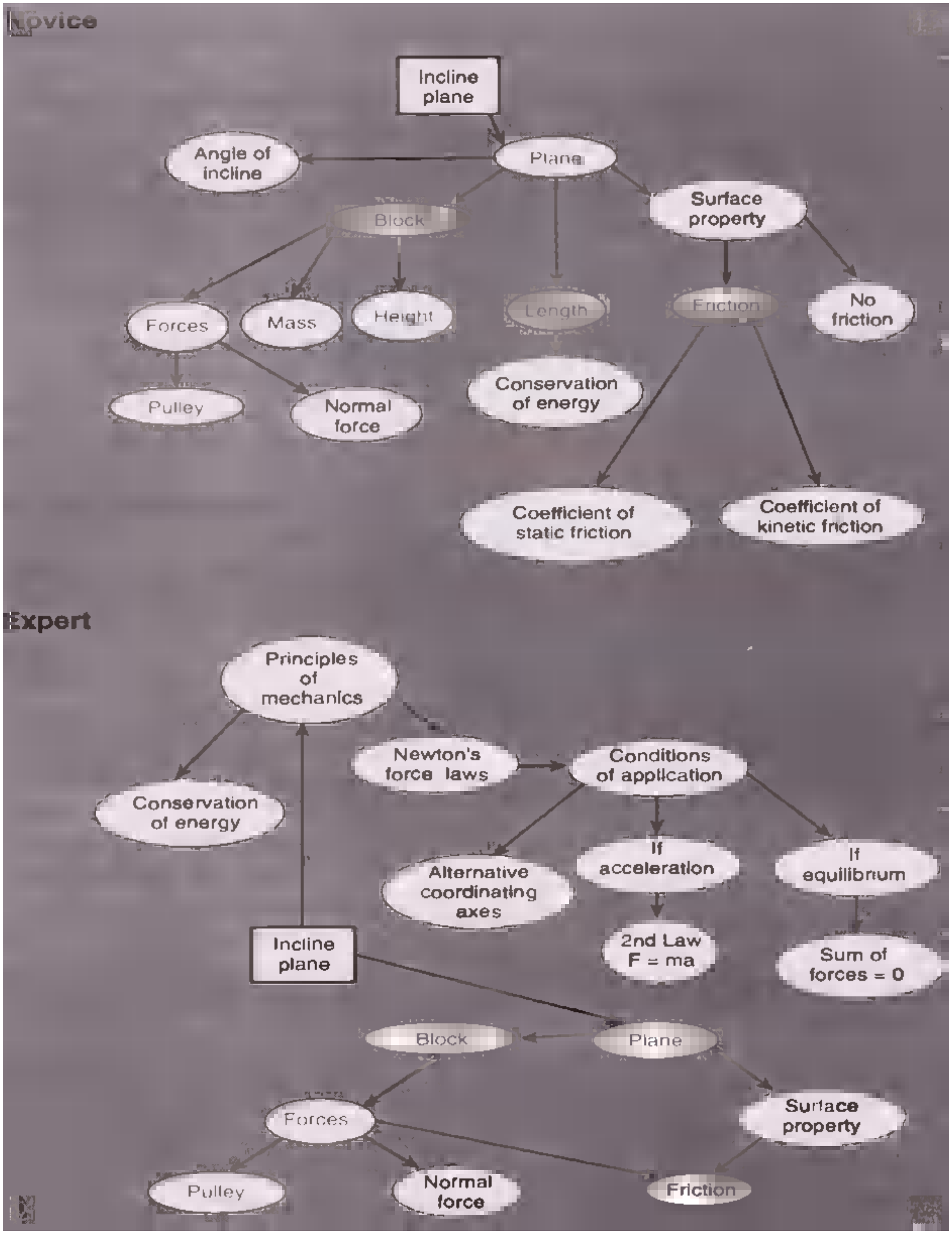
with little attentional effort.
5. Though experts know their disciplines thoroughly, this does not guarantee that they are able to teach others.
6. Experts have varying levels of flexibility in their approach to new situations. (p. 31)

In discussing "meaningful patterns of information," the NRC (2000) authors examine some studies on chess players (experts) and how they "chunk meaningful information together," making it more possible to extend short term memory capacity. Novices do not have the hierarchical, highly organized structure of domain to use "chunking" (DeGroot, 1965). Other types of experts have similar skills, for example, experts in electronic circuitry and computer programming (Egan & Schwartz, 1979; Ehrlich & Soloway, 1984). Electronics technicians can

> reproduce large portions of complex circuit diagrams after only a few seconds of viewing; novices could not. The expert circuit technicians chunked several individual circuit elements (e.g. resistors and capacitors) that performed the function of an amplified. By remembering the structure and function of a typical amplifier, experts were able to recall the arrangement of many of the individual circuit elements comprising the amplifier chunk. (p. 33)

Mathematics experts, physicists, and expert teachers have developed these expert "schemas" or organized conceptual frameworks that guide how one processes information (Glaser & Chi, 1988; Hinsley, Hayes, and Simon, 1977; Robinson & Hayes, 1978; Scarborough, 1984). Schemata, the frameworks, and "chunking," a process, are capabilities developed by experts over time. If we were to dig more deeply into the field and subfields of the information process, we would get into breaking out the units individuals are capable of processing, coupled with how they learn something: the resulting outcomes. For example, the Scarborough study engaged the researcher in the breakdown of all information to be learned into memory units as part of the process of preparing the learning materials for the experiments. When considering the organization of knowledge, experts' knowledge is "organized around core concepts or 'big ideas' that guide their thinking about their domain" (NRC, 2000, p. 36). This affects how they understand and represent problems. The NRC report thoroughly discusses this and provides examples.

Figure A.6.11: Network Representations of Incline Plane Schema of Novices and Experts



(Chi, Glaser, & Rees, 1981)

Another difference between experts and novices is one of accessing knowledge or retrieving what is relevant to a particular task. Their knowledge is "contextualized – includes a specification of the contexts in which it is useful" (Glaser, 1992, pp. 42-43; Miller, 1956; Simon, 1980). This concept has important implications for teaching, assessment, and curriculum development. It is important that all three help students begin to "contextualize" knowledge as they learn it. When considering assessment in light of "contextualization," it is important to understand that many tests fail to engage students in determining when knowledge is to be useful. For example, when mathematics students are "asked whether the formula that quantifies the relationship between mass and energy is $E=MC$, $E=MC^2$, or $E=MC^3$, a correct answer requires no knowledge of the conditions under which it is appropriate to use the formula" (Glaser, p. 43). Therefore, "fluent retrieval" involves a number of sub processes that vary from fluent to automatic. This does not mean that experts access or process faster because they approach problems more deeply, trying to understand it and thus often take more time. Developing fluency is important because in doing so, there are fewer demands requiring conscious attention. The easier the processing, the greater one's capacity to tend to other aspects of the task (Anderson, 1981, 1982; LaBerge & Samuels, 1974; Lesgold et al., 1988; Miller, 1956; Schneider & Shiffrin, 1985). A good example is driving a car. For the most part, expert drivers can multitask while driving, without getting into a wreck. Experience builds that fluency to assess information subconsciously while attending to other tasks consciously. Analogously, novice readers who are less fluent in decoding works cannot focus on understanding what they are reading because they are inexperienced in reading. Those who read well (also keyboard well) do not process in single words; they process in phrases, then sentences, and then paragraphs as they become more expert. Speed readers may not remember the exact wording; they read only for meaning or essence.

Adaptive expertise is highly critical. This means that some ways of organizing knowledge help people to be more flexible and adaptable to new situations requiring the use of knowledge. Experts can be skilled, or beyond that to highly competent, because they can adapt knowledge more readily to meet external or changing demands: a cook versus a chef who can improvise and create when surprised by an unexpected request or an artist versus a virtuoso who creates while entertaining. Adaptive expertise is not bounded; in other words, one can use it in unexpected and unplanned ways. When designing information systems, the designer could consider him/herself "bound" by the technical specifications described by the customer or he/she could consider those specifications the lowest level of performance and as a point of departure or for further exploration.

Adaptive expertise is really the ability we want to develop in our students and in ourselves because this ability creates the continuous lifelong learner who is never bounded by moment, job, assignment, or company. "Adaptive learners are able to approach new situations flexibly and to learn while engaged in something new" (Glaser, 1992, p. 47). A very good example of that is when someone is most satisfied being given an assignment for which they do not really know everything needed to accomplish the assignment. Adaptive learners are happiest in this type of scenario, whether in school or at work. Adaptive learners use what they have learned and learn while engaged; they

operative metacognitively, continuously challenging or seeking higher levels of expertise – more often than not, subconsciously. They attempt to move beyond where they are all the time. They do NOT simply do the same things more efficiently (in this they become very quickly bored, unmotivated, and unsatisfied); instead they attempt to understand things more deeply, do things better or differently, challenge the status quo, and seek change. These are our virtuosos, whether faculty members or our students. This is our goal!

Implications for teaching – it is not possible to assume that because someone is an expert in a discipline they can then teach it. They often forget what is difficult, thus their instruction becomes ineffective. That is why it benefits us to work in interdisciplinary groups. Also disciplinary knowledge is not the same as pedagogical knowledge. We understand that in this initiative; thus our faculty members are exploring major content areas related to teaching and learning: course analysis, test analysis, development of student learning outcomes, assessment planning, test development, performance assessment development, teaching models, educational research, and a myriad of subtopics. They will then design experimental pilots to guide classroom research with students on learning.

The NRC (2000) report goes further to discuss other aspects of learning with direct implications for teaching. Transfer of learning is essential to understanding the development of competencies. Transfer of learning is "the ability to extend what has been learned in one context to new contexts" (Byrnes, 1996, p. 74). The results are different when testing for learning versus testing requiring transfer of knowledge. Research on this has changed in focus; it retains the "practice" component but works toward understanding the difference in results across kinds of practice. Today's research on transfer also considers learner characteristics (e.g. existing knowledge and strategies). Key characteristics to consider about learning and transfer are

- Initial learning is necessary for transfer, and a considerable amount is known about the kinds of learning experiences that support transfer.
- Knowledge that is overly contextualized can reduce transfer; abstract representations of knowledge can help promote transfer.
- Transfer is best viewed as an active, dynamic process rather than a passive end-product of a particular set of learning experiences
- All new learning involves transfer based on previous learning, and this fact has important implications for the design of instruction that helps students learn. (p. 53)

Elements that promote initial learning relate to the degree of mastery of the original subject; otherwise there is not enough of a basis for transfer. Transfer can be affected by the degree people memorize versus understand and how much time they are given to learn, especially if a complex subject matter. The amount of time provided must be directly proportional to the complexity of the material. If the meanings are not initially clear, it will take learners time to process and reach the point of some understanding. Moving too quickly with too many concepts will inhibit learning and understanding, as they will learn only isolated facts rather than creating organizing principles that make

meaning and bring about understanding of learning. But they need enough time to process new or expanded knowledge. Deliberate practice is encouraged, especially to include monitoring one's own learning experiences where feedback is sought and used – critical to successful learning (Chi, Bassok, Lewis, Reimann, & Glaser, 1989, 1994; Ericsson, Krampe, & Tesch-Romer, 1993; Thorndike, 1913). One method that is successful in deepening understanding is to "contrast" when, where, and why to use new knowledge.

This returns us to the "contextualization" of knowledge thoughts presented above. Transfer is learned better if students can see potential transfer implications related to what they are learning. Therefore, these contrast opportunities can be beneficial toward that end as well. "Competence motivation is the amount of time people are willing to devote to learning" (NRC, 2000, p. 60). Most human beings are motivated to develop competence and to solve problems, working hard for intrinsically rewarding reasons. The level of difficulty can be defined by the challenges presented. There must be a match of difficulty to ability to maintain motivation because if tasks are too difficult <u>or</u> too easy, learners lose interest because of boredom or frustration. If learners who are performance oriented are concerned about errors, those learning-oriented like new challenges (Dweck, 1989). Learners are motivated by social opportunities to learn because of feeling like they are contributing to others (Schwartz, Sin, Brophy, & Bransford, 1999). If learners see usefulness in what they are learning and that they can use what is learned to impact others, they are also more motivated (McCombs, 1996; Pintrich & Schunk, 1996; Vanderbilt, 1998). Other factors affecting transfer can be the a) the learning context of the original learning and b) representation of problems at higher abstract levels, meaning that if problems are presented so specifically, students will want to transfer their solutions inappropriately. It helps students to generalize their solutions. Students need to understand the underlying principles, and a "suite of representations" enables them to more flexibly transfer (Spiro, Feltovich, Jackson, & Coulson, 1991).

Transfer can be perceived as a relationship between learning and transfer conditions: "the amount of transfer will be a function of the overlap between the original domain of learning and the novel one" (NRC, 2000, p. 63). They also argue that "transfer is a function of the degree to which the tasks share cognitive elements" (NRC, p.65; Thorndike & Woodworth, 1901; Woodworth, 1938). Often in technical fields, we limit learning about theory or contain the process of abstractions; Biederman and Shiffrar (1987) and Anderson, Reder, and Simon (1996) found benefits from providing students 20 minutes on abstract principles before engaging them in the task to increase learning. There is more research providing strong support for learning benefits by helping students represent their experiences at more abstract levels because it helps them transcend the specificity of particular contextualized learning or examples (Klahr & Carver, 1988; NRC, 1994; Singley & Anderson, 1989). The NRC report goes further to discuss active versus passive approaches to transfer and to transfer and metacognition, meaning that students become more aware of themselves as learners and monitor their own growth and learning strategies, resources and become able to assess their readiness for tests and performances. Metacognitive approaches to learning seem to positively affect the degree to which students will transfer to new situations without explicit prompting (active /

passive transfer). One of these methods is "reciprocal teaching," where teachers and students take turns leading the learning (NRC, p. 67).

It might be important to consider learning as transfer from previous experiences. Very often people think of transfer as learning something and then applying it somewhere else. However, the NRC (2000) report establishes that even initial learning requires transfer because people bring knowledge to any learning situation, even initial ones. Thus "all learning involves transfer from previous experiences" (p. 68). The implications are that students may have inactivated knowledge relevant to what is about to be learned, which when activated can build on student strengths. Previous knowledge can lead students to misinterpretation of new knowledge when they begin to try to construct understandings or meanings. One I find very interesting and have dealt with before is that students may find the teaching practices conflict with those they have experienced before. For example, NIU Mathematics requires, or did, manual calculation of equations on their mass tests, no technology-calculators-allowed. This has been hypothesized to distract students coming from other learning environments who were allowed to use technology, causing them to perform less well. NIU's argument is that they can better assess student understanding; however, one feeder institution changed its tests and improved items so that measurement of understanding could be attained using technology. So building on existing knowledge can be beneficial or can cause difficulties in learning. There can also be a conceptual change in knowledge. "Teaching by telling," direct instruction, or lectures can be dangerous because when learners construct new knowledge or meanings based upon current knowledge and conditions are unclear because of lack of conditions, broader examples, contrasts, situations, they may not be able to continue to build knowledge accurately (p. 71). The role of culture needs to be considered. If there is a mismatch between home and learning environments, difficulties may arise, which seems to me to be more of an issue in K-12 than in higher education.

The design of learning environments has multiple important considerations. They should be integrated and learner centered, knowledge centered, and/or assessment centered with formative assessments using feedback, and then ultimately have a summative assessment or evaluation (NRC, 2000).

Figure A.6.12: Perspectives On Learning Environments

(Bransford et al., 1998 as cited in NRC, 2000, p. 143)

Transforming Knowledge

A learning community is one where constructivism, reflective practice, and collaboration are alive and functioning well. Knowledge is constructed. Knowledge, application, and learning are deepened through reflection, and as established above, learning is enhanced through the social process of collaboration (Sullivan & Glanz, 2006). Scarborough (2001) found when interviewing manufacturing leaders that reflection was a necessary, rewarding and productive component of their daily process as leaders; in fact, they realized they must have a "quiet time" each day to process what had occurred and generate a response or the next step. Therefore, reflection is not just a phenomenon within the educational or teaching context, it is truly a requirement of effective leaders or performers in other sectors. Learning communities are not unique to education; they do or should exist in every type of organization as a means to accomplish ongoing, effective, purposeful, meaningful, and continuous change.

In beginning our thoughts about knowledge, Stacey (2001) defines it as

> a process, and a relational one at that, which cannot therefore be located simply in an individual head to be extracted and shared as an organizational asset. Knowledge is the act of conversing, and learning occurs when ways of talking, and therefore patterns of relationship change…The knowledge assets of an organization lie in the pattern of relationships between its members. (p. 98)

Thomas et al. (2005) focus mostly on Gardner's work described below. But they do make some important observations. Although we may have learning style preferences as learners, life requires us to use multiple styles. Solving problems, for example, requires us to recall information, but it also may require us to take some action using our bodies or oral linguistic skills, etc. Experiential learning (to be discussed more thoroughly in pedagogy) combines theory with experience, mirroring reality, solving problems through the application of knowledge, beginning with the present and moving one forward to the future. Projects, if designed accordingly, provide the opportunity for learners to discover knowledge or construct it for themselves, requiring individual and collective thought and problem solving. Traditional education, and this includes professional development for faculty, often requires listening, memorizing, and then repeating what can be recalled. That process starts in the present and moves learners, whether students or faculty, backward to the past, requiring them to remember what others have already discovered rather than discovering through projects that engage them in the construction of knowledge. In this scenario, we provide learners with the answers rather than questions and problems, indicating that the more one can remember, the more one knows. This does not make problem solving a theory in learning. In society, however, learners are required to actively plan, observe, test, and reflect rather than the other more passive approach. Teachers (professors) might consider this question, "how can one learn to be an effective teacher without actually teaching?" (p. 78). This means that teaching is defined differently than "imparting [or dumping] information into repositories" students' heads, where the burden of learning is on the teacher. Active or inquiry-based learning puts the burden equally on the student, requiring them to explore the unknown. One is static: the model above where recall is all that is required; however, knowledge is dynamic, always

changing because we begin with the present and move towards the future. This process requires problems, problem solving, and self-directed and collaborative learning.

For adult learning (the learners in this initiative or college age students), Wald and Castleberry (2000) identify five assumptions:

> inquir[ing] into underlying assumptions deepens the learning process; learning is an active process that occurs over time; learning is driven by the learner around meaningful issues; learning is experiential by nature; and learning is fueled by rich, diverse, accessible sources of information. (p. 110)

Although how learning best occurs is to be thoroughly discussed later, it is important to weave thoughts on it into other sections. We have required our participants to engage in active learning around meaningful issues and for authentic purpose. Minnich's (2005) book is extremely enlightening when considering knowledge and its meanings. Although it is fairly impossible to simplify and distill its contents while holding to her complex, yet noteworthy, presentation about the topic (transforming knowledge), I will try to at least stimulate readers to get the book and read it on their own. Minnich presents the transformation of knowledge from a socialized context, bringing to this project a broader viewpoint from the perspective of gender, class, and race. Her explanations are critical when working with multicultural partners in the academy and equally important for considering how best to achieve learning and making meaning when teaching a multicultural student body. In her discussion on rationality, intelligence, and good papers, she realized when performing a classroom experiment that the group that seemed to be more intelligent in writing their papers had heard her recognize that "the academic paper was only <u>one</u> form or way of achieving, expressing, and communicating fully 'rational' understanding" (p. 182). She recognized that each student is capable, "when working from her or his own strengths, of excellent rational work. We pay a high price collectively as well as individually for 'training' so many wonderful minds into too <u>few</u> modes" of performance options (p. 183). She goes further to acknowledge the wide range of modes her "thinking" friends and students cross: "analytical, synthetic, factual, imaginative, holistic, atomistic, relational, argumentative, suggestive, symbolic, juxtapositional, oppositional, deductive, indicative, narrative, poetic, concrete, intuitive, abstract, totalizing, particularizing, [and] dramatic" (p. 183). When we define rational as only one mode, we exclude all the other modes and all those who rationalize (learn knowledge and make meaning of that knowledge) using those modes.

Minnich (2005) considers transforming knowledge from the perspective of inclusion, across races and genders, and discusses who may be excluded if opportunity is limited or not available because of who someone is. She is very concerned with "dominant meaning systems," where the dominant culture results in particular groups being shut out or excluded and where there are distortions that occur because of exclusion. She discerns the importance of curricula and its role in working to understand the new rather than a continuous unfolding of all that has already been established and notes that we must remove such distortions – thus "that which is actively excluded from the curriculum is very likely to be forgotten, seen as deviant and marginal" (p. 59). Making meaning must be open to everyone, not dominated by any one perspective or definition, where the past

and future are bridged, so new generations will make more relevant meaning. She rejects "mainstreaming" because it implies that there is one main stream (that normal is the goal) and uses a metaphor of becoming invisible in a big river. One of her most significant points is that "transformation, in contrast, places the emphasis not on joining what is, or on adding something onto it, but on changing it" (p. 60). She warns against circular reasoning, where "circularity extends the error of generalizing too far from too few into the standards by which the hierarchy is maintained to such an extent that the few reappear, tellingly, as the 'ideal'" (p. 156). Prejudice is one kind of circular reasoning. This means that established judgments are not reconsidered in light of new experience or evidence that changes those judgments. Our students are also prejudiced in that sense. They feel that any group excluded was rightfully excluded. "A citizenry that is humanistically aware is a citizenry that is capable of confronting diversity, ambiguity, and conflict, overcoming prejudice and self-interest, enlarging its sympathies, tackling tough public issues, and envisioning possibilities beyond the limits of circumstance" (The Humanities and the American Promise, the National Endowment for the Humanities-A Report, as cited in Minnich, p. 166). Rather than considering our curricula as a set of academic disciplines, it is more enlightened to consider them as "certain ways of thinking – inquiring, evaluating, judging, finding, and articulating meaning" (p. 167). Minnich discusses many of our social situations to illuminate thought on how transforming knowledge can be dominated through exclusionary practices.

Transforming knowledge, simply, is to create meanings. Humans learn through creating meanings, which can vary across groups. But we are "conscious creatures and creators of meaning" (Minnich, 2005, p. xxi). Very few words are neutral; they are usually personally, intellectually, historically, culturally, politically, and/or often racially charged. Words reflect knowledge and meanings of the times and the situations in which they come into use. Words have multiple, sometimes contradictory, meanings over time, especially across cultures and subcultures. When considering meanings,

> one is trying to comprehend a (re) framing of available meanings, a task that requires attention to each word, each line, each section within the context of the entire work, itself read within its own multiple contexts. In this process of reading, listening, opening to take in "what is going on here," philosophical readers, like effective political actors, attentive parents, good teachers, artful psychological and pastoral counselors, listen for how what is said coheres, and [what] does not; how it is familiar and strange; [and] how it invokes and suggests, and suppresses things not directly said. They listen for recurring images and for what sorts of relations those images privilege (mechanical? organic? rigid? fluid? oppositional? transactional?). They pick up on language use and what it suggests: why the colloquialism here, the technical term there? Why that rhythm in those sentences, another in these?
>
> We all do all of that – and more, of which we are rarely aware – to be fully present within a conversation as it is happening here and now, with these particular people. We can do that because and insofar as we also always hold in mind other, differing conversations. Making sense with one another, which is both enabled and limited by culturally framed interactions, is an ongoing project

> that can never be completed. It is a transactional process that has no products but does have crucial effects. And those effects are of great importance: through them we can be deformed as well as informed, and sometimes even transformed.
>
> There is nothing trivial or 'only' theoretical about how people in their daily lives make sense together, and this ongoing process is particularly significant when we are trying to make sense of who or what "we" are, of who and what "they" are. In doing so, we are making and remaking our lives and possible relations with others and with the earth we share. So calling on every art of listening…, and trying always to practice it better, … to locate where and how efforts to connect with others are distorted into prejudicial--preformed, unreflective, and so potentially dangerous – forms….The danger lies in mis-taking what is before us by forcing it into frames of meaning within which it cannot reveal its unruly uniqueness.
> (pp. 4-5)

> The history of thought [in contrast to the history of ideas] is the analysis of the way an unproblematic field of experience, or a set of practices, which were accepted without question, which were familiar and "silent," out of discussion, becomes a problem, raises discussion and debate, incites new reactions, and induces a crises in the previously silent behavior, habits, practices, and institutions. The history of thought, understood in this way, is the history of the way people begin to take care of something, of the way they become anxious about this or that. (Foucault, 2001, p. 74 as cited in Minnich, 2005, p. 5)

> Foucault…calls us into recurrently fresh thinking, instead of being adopted as yet another method to be learned and applied. (Minnich, 2005, p. 5)

Whether we are discussing the transformation of knowledge into useful meanings by our students or the transformation of knowledge by ourselves, professors in higher education, into useful meanings by the study of something, a challenge occurs, one of which (for us) is "How do thinking and knowledge relate to the 'real world'?" Personally, as much as I agree with some of the thought presented above about the academy being a separate place where thought and study should rein free safely, I also believe that when we, professors, are perceived in that manner and not considered part of the "real world" that implies we are not "working." For those of us who are dedicated to our fields, students, service, and to using our knowledge and study to evolve solutions or new directions, we are part of that real world. Especially when we are striving to extend students' minds and capacities, we are very much part of that real world, often struggling with how to challenge and lead students to achieve their highest potential with us, constructing knowledge about how to do just that – increase student learning. Over the past 30 years, higher education has learned, changed, and learned, and it continues to do so. There have been new initiatives, new curricula, new institutions within the academy (e.g., Center for Intercultural Relations, Women's Center, Center for Study of Social Change, and many more).

Finally, there are those professors who still teach in lecture halls where the seats are bolted down in neat lines, with a lectern and screen, etc. However, there are also those professors who have created a different learning environment where students sit around round tables or in study rooms informally; there are distance courses where students can interact regardless of where they are (or at least when the technology is working and professors have designed their courses for technological interaction). There is a movement for engaged learning, active learning, and/or student/faculty learning communities. This is what we are about. We are going to transform knowledge into new meanings for us individually and collectively as teaching professors, with the intent of changing how our students transform knowledge in our courses. Students have changed, but often we have not. The best of us has changed, is willing to be unsure about meaning, and has the capacity to build meaning with students rather than for students. Otherwise, we become "a professor [who] is no more competent than memory banks in transmitting established knowledge" (Lyotard, 1988, p. 53).

To save the day, new ways of thinking are emerging from the academy. Some of the shifts are from singular to plural, "students" rather than "the student" because singular terms often hide complexities, while plural terms help us to acknowledge differences, make relevance, and move towards achieving transcendent unity. Plural is more inclusive. Another shift is from nouns to verbs, implying a more active position away from static, which possibly helps us to focus on complex and interrelating systems rather than on static products and abstractions. Changing language reflects a shift from asking what "knowledge is" to asking how something "becomes knowledge" and whether it makes a difference. For example, Focault (2001) did not think about "problems," he thought about "problematizing," changing the verb from static to dynamic or active, which leads to another shift where singular and static, related to externally, are defined by what they are not, as if they could not be something else – fixed.

A third shift is one of relationalities where relationalists change from external or "additive" to internal or "transactional": when being Black differs for men and women; being Chinese differs from being Chinese American. "These identities are imposed, internalized, and more or less freely chosen; they are woven of many strands, sustained, and challenged through many sorts of daily interactions. They are no 'kinds' that we simply 'are', one by one, additively, nor do they intersect only at some points" (Minnich, 2005, p. 12). Transactional relations focus on relations, not static things, that enable one to visualize the practical, applied, and political side of theories or abstractions. These have embedded past practices that, when applied, could confirm and continue its meaning, or we can realize that generalizations or historical implications came out of particular social realities and be careful not to use them when inappropriate. We are to continue the process of expanding, refining, and creating new meanings of those theories and practices. This leads us from divided to mutually formative theory and practice, yet another shift. **This is the new scholarship in the academy. We are to make new meanings that then translate into providing new approaches or opportunities for our students to make new or to extend and deepen meanings. A good example of these transitions is that our word processors do not yet reflect the shifts or their vocabularies (e.g., "narrativizing, significations, pluralize") that move from static to**

active. This can represent our own resistance to new directions. On the other hand, some of us value new language because it represents new directions, thoughts, and meanings. Living languages should be limber, although at times they may need to be realigned to correct that locked in; we do not want to substitute an old rigid for a new rigid posture. These changes are to stimulate our minds, to enable us to think more openly and flexibly, and to enable us to be more responsive, as opposed to reactive.

Minnich (2005) goes further to establish that critiquing curricula is critical because of the framework of meaning behind particular questions of what to teach and to whom. Curricula engage us in knowledge making and participation in understanding. In a discussion about "distinguishing thinking from knowing," she establishes that

> we are not only capable of knowing – achieving specific answers to questions that can then be taught and learned in ways that shape cultures and so human worlds – but of thinking about what we know, and so also thinking beyond knowledge…that [Plato] questioning dissolves certainties, beliefs people hold as knowledge (conventional or formal), thereby reopening minds, reawakening curiosity, and, not incidentally, drawing people back into discussion with each other that equalizes them as lovers of wisdom none of them possesses. (p. 113)

Considering <u>partial knowledge</u> is important. Our courses reflect and perpetuate a sort of partial knowledge from Minnich's perspective. Our courses only access <u>parts of a total subject</u>. Often that subject matter is already predefined too narrowly and is presented in such a way as to imply that it is the 'whole' subject and uses definitions where anything else is judged to be wrong or inferior, etc. Although I clearly and often state to my students that there is so much content for us to choose from and that we can only engage in making meaning about a selected set of concepts, topics, etc., the concept of "partial knowledge" brought about a deeper meaning and understanding of what I was trying to express.

All of our subject matter is complex; we must make choices about what to study with students and how deeply to consider the knowledge and its uses. That is often difficult, and often disastrously, we rely on textbooks to make those choices for us without understanding or realizing the ramifications. We must realize that curricula can and should continuously be reviewed and changed. This is an exciting challenge to those scholarly and professional teaching professors, the inquiry-oriented scholar who practices the art of translation, but is not always easy for those professors whose success is dependent upon their established identity as a specialized authority on a discipline. However, when considering that those who teach, especially scholars, should be used to conceptual diversities in their fields, there should be little difficulty when confronted with change, regardless of whether change is with course content, teaching methods, and new inquiry. Professionals are or should be oriented and excited by the challenges it presents and its potential results. However, sometimes professional identities (or lack of), attitudes and ambitions, personal tastes and styles do get in the way of being a professional. Sometimes the practice of tolerating differences among ourselves and our students gets in the way of engaging in authentic communication to transform knowledge, whether as scholars or as leaders of student learning. Thinking is entwined with acting.

Finally, in considering the transformation of knowledge, one must realize that it is relative. Making meaning depends upon how.

> Teaching rests on the faith that, although we differ and may have different stakes in learning and in what is available to be learned, we can nevertheless approach comprehension even of that which appears to be utterly outside our own experience. How else can we translate the past into terms accessible to newcomers, to students? How else can we study differing schools of thought, let alone cultures? Translation across such lines is possible, and the effort to achieve it rewards us not by giving us more of 'the same,' but by revealing mutually enriching differences along with discernible similarities. Good teachers and good scholars are not restricted to teaching their own perspectives, views, espoused theories, or cultures. They are, pre-eminently, creative translators. It is a way of thinking, the way which imposes itself when the object is 'different,' and requires us to transform ourselves. [When we] let ourselves be taught by another culture…a new organ of understanding is at our disposal--we have regained possession of that untamed region of ourselves, unincorporated in our own culture, through which we communicate with other cultures. (Merleau-Ponty, 1964, p. 120)

Important to consider is Minnich's (2005) presentation about faculty generalizations and hierarchic monism, meaning that some (most) of us have a sex/gender, class, and race implicating stratification system – kinds of human beings and that this affects our relations. In my opinion, this realization can free us or it can bind us in our curricula and expectations of each other and students, and it can be reflected in our teaching.

Transformative Learning

Learning as transformation is also an important viewpoint to consider. Although still focused on "making meaning," it is more from the perspective of making meaning as a learning process. Knowledge is not permanently definitive, as there are no fixed truths. Making meaning occurs and depends upon our level of awareness and understanding, the conditions that exist, our level of development, child to adult. Bruner (1996) identified four modes of making meaning:

1. establishing, shaping, and maintaining intersubjectivity;
2. relating events, utterances, and behavior to the action taken;
3. construing of particulars in a normative context – deals with meaning relative to obligations, standards, conformities, and deviations;
4. making propositions--application of rules of the symbolic, syntactic, and conceptual systems used to achieve decontexualized meanings, including rules of inference and logic and such distinctions as whole-part, object-attribute, and identify-otherness. (p. 93)

A fifth mode of making meaning was added to Bruner's list by Transformation Theory.

5. becoming critically aware of one's own tacit assumptions and expectations and those of others and assessing their relevance for making an interpretation. [Mental models, existing frameworks, schema, etc.].

In our initiative, we have chosen Bloom's Revised Taxonomy of Cognitive Learning (Anderson & Krathwohl, 2001). Kitchener (1983) suggests three levels of cognitive processing:

> At the first level, individuals compute, memorize, read and comprehend. At the second level [metacognition], they monitor their own progress and products, as they are engaged in first-order cognitive tasks…The third level…[the] epistemic cognition, must be introduced to explain how humans monitor their problem solving when engaged in ill-structured problems, i.e. those which do not have an absolutely correct solution. Epistemic cognition has to do with reflection on the limits of knowledge, the certainty of knowledge, and the criteria for knowing…. Epistemic cognition emerges in late adolescence, although its form may change in the adult years. (p. 230)

We learn as we go through the process of using a prior interpretation to construe a new or revised interpretation of the meaning; this can guide future action. Rosenfeld (1988) describes this as the appropriation of symbolic models that are composed of images and conditioned affective reactions from our culture or upbringing, our individual frames of reference. We then make analogies to interpret the new meanings of new experiences. Learning can be intentional and can be the result of deliberate inquiry; it can also be incidental or serendipitous. One can be fully aware when learning takes place or be completely unaware. In learning, we use language to articulate it to ourselves or others. However, there is a type of learning where words are not necessary to make meaning, that of presentational learning (e.g., experiencing motion, color, aesthetic, empathy, appreciation). Language is used when we want to share an experience. Beliefs are not usually encoded with words but rather by interactions and generalizations.

Weiss (1997) says:

> Indeed, research into the unconscious acquisition of knowledge demonstrates that the human being has an enormous capacity nonconsciously to make inferences from complex data, to solve difficult puzzles, and to make broad generalizations from particular experiences…
>
> [T]he nonconscious capacity of people to acquire information is much more sophisticated and rapid than their conscious capacity to do this. Also human beings have no conscious access to the nonconscious process that they use to acquire information. People cannot describe them; they are conscious only of the results of their nonconscious mental activities. (p. 428)

There are a lot of ways to make meaning. Cognition has strong affective and cognitive dimensions in which a person's sensitivity and responsiveness interact to invent, discover, interpret, and transform meaning. Transformative learning can be a highly emotional and intense experience. This is often when we become aware of the need to change. Important to note is that the "who, what, when, where, why, and how of learning may be understood as situated in a specific cultural context" (Mezirow as cited in Mezirow et al., 2000, p. 7). We are connected as humans; that is common with the desire to understand. However, culture either enables or inhibits the realization of common interests, methods of

communicating, and the realization of learning capabilities. Langer (1997) defines learning mindfully as "the continuous creation of new categories, openness to new information, and an implicit awareness of more than one perspective," whereas mindlessness learning "involves relying on past forms of action or previously established distinctions and categories" (p. 4). This resonates with me, especially in light of what we are trying to accomplish through this initiative. Transformative learning is a process where we change or transform our pre-existing frames of reference or schemata (e.g. mindsets, assumptions); where we extend them to be more inclusive, open to change, and reflective; and where we begin to generate different beliefs or opinions more true present than our past ones. Through discourse, we construct new meanings from the experiences of others and then take actions based upon new insights. Transformative Theory moves us to negotiate and take action on our own purposes, values, and meanings rather than merely acting on those of others; therefore, we gain control over our own lives and begin to make our own decisions.

Mezirow discusses Habermas's (1984) domains of learning, instrumental and communicative. Instrumental learning relates to learning to control or manipulate the environment or other people, where there could be task-oriented problem solving to improve performance. Communicative learning is more focused on determining what others mean when they communicate with you, establishing their values, intentions, or moral issues. This engages individuals in the assessment of meanings behind another's words to determine assumptions, truths, or appropriateness. It might involve establishing the qualifications of the speaker and their authenticity. For example, when others are directing us at work, we need to determine if they are authorized to do so. When determining the assumptions underlying someone's words, one has to consider intent, wisdom, worldview, literal or metaphoric meaning, and more. Most of our learning involves both domains. Reflective discourse, from Transformational Theory, is the use of dialogue to determine common understanding or the assessment of a justification of an interpretation. It involves critical assessment, especially of assumptions, and often results in clearer understanding. Emotional maturity is required if discourse is to be effective. Goleman (1998) and others have constructed what is known as emotional intelligence or EQ as when one can manage emotions well as well as handle relationships effectively and can recognize and motivate positive results from others' emotions: clear thinking, empathy, self-control and trustworthiness. Goleman claims that most of the success at work is a direct result of EQ. The culture of the U.S. is argumentative, where we compete individually to win or lose. It is not the best culture for collaborative thinking, and although one of our strengths as a nation, conversely, it is also one of our weaknesses. Effective discourse is not based upon winning arguments but rather on the "trying on" of other viewpoints. Bruner's (1990) definition of open mindedness is "a willingness to construe knowledge and values from multiple perspectives without loss of commitment to one's own values" (p. 30). It requires "epoch" or "a provisional suspension of judgment about the truth or falsity of, or the belief or disbelief in, ideas until a better determination can be made" (p. 31). To most effectively engage in discourse where there is open mindedness, participants must have the following ideal conditions:

- more accurate and complete information
- freedom from coercion and distorting self-deception

- openness to alternative points of view: empathy and concern about how others think and feel
- the ability to weigh evidence and assess arguments objectively
- greater awareness of the context of ideas and, more critically, reflectiveness of assumptions, including their own
- an equal opportunity to participate in the various roles of discourse
- willingness to seek understanding and agreement and to accept a resulting best judgment as a test of validity until new perspectives, evidence, or arguments are encountered and validated through discourse yielding a better judgment. (Mezirow, 2005, p.13)

Meaning structures, or frames of reference (schemas), are those (models) structures of assumptions and expectations used to filter our impressions. These shape or delimit our cognition and disposition and provide our context for making meaning. Frames of reference change as we construe meanings. A frame of reference has two elements, a habit of mind – the set of assumptions or predispositions acting as our filters – and resulting points of view. The following are examples of habits of mind:

- Sociolinguistic (cultural, ideological, social norms, customs, language games, etc.)
- Moral-ethical (conscience, moral norms)
- Epistemic (learning styles, sensory preferences, focus on whole or parts; concrete or abstract)
- Philosophical (religious, philosophical, transcendental world view)
- Psychological (self-concept, personality types, repressed parental prohibitions dictating feelings and attitudes, emotions, etc.)
- Aesthetic (values, tastes, attitudes, standards, and judgments about beauty; insight and authenticity of aesthetic expressions, the humorous, etc.) (Mezirow, 2005, p. 16)

These can generally be described as conservative or liberal in orientation: the tendency to move toward people or away; the way one approaches the unknown, fearfully or with confidence; the preference for being alone or with others; ethnocentricity - viewing others who are different negatively or interestingly; tendency to challenge authority or respect it, focusing on a problem holistically or in parts; and so much more. A habit of mind is expressed as a point of view where clusters of meaning schemes are comprised of expectations, beliefs, feelings, attitudes, judgments, etc. These are usually outside of awareness and occur subconsciously unless engaged in critical reflection. We are "anchored" in our frames of references. They establish our identity, and we judge other points of view against them. Learning is often perceived as the effort to add to our "fixed" frames of reference. Transformative learning changes this learning predisposition and enables one to become more flexible, more inclusive, less narrow, emotionally capable of change, and through doing so, much more dependable. Transformations can occur in four ways:

1. by elaborating existing frames of reference
2. by learning new frames of reference
3. by transforming points of view

4. by transforming habits of mind (Mezirow, 2005, p. 18)

Transformation occurs over time, during which individuals reformulate structures of meaning. This happens as they reconstruct dominant narratives or predispositions. Possibly, the process of reconstruction, the dispositional orientation or openness to change, could be considered a fifth way that transformations occur. The capability of critical reflection positions one to transformational learning. There are three assumptions essential for critical reflections:

- paradigmatic assumptions that structure the world into fundamental categories (the most difficult to identify in oneself)
- prescriptive assumptions about what we think ought to be happening in a specific situation
- causal assumptions about how the world works and how it may be changed (the easiest to identify) (Mezirow, 2005 , p. 19)

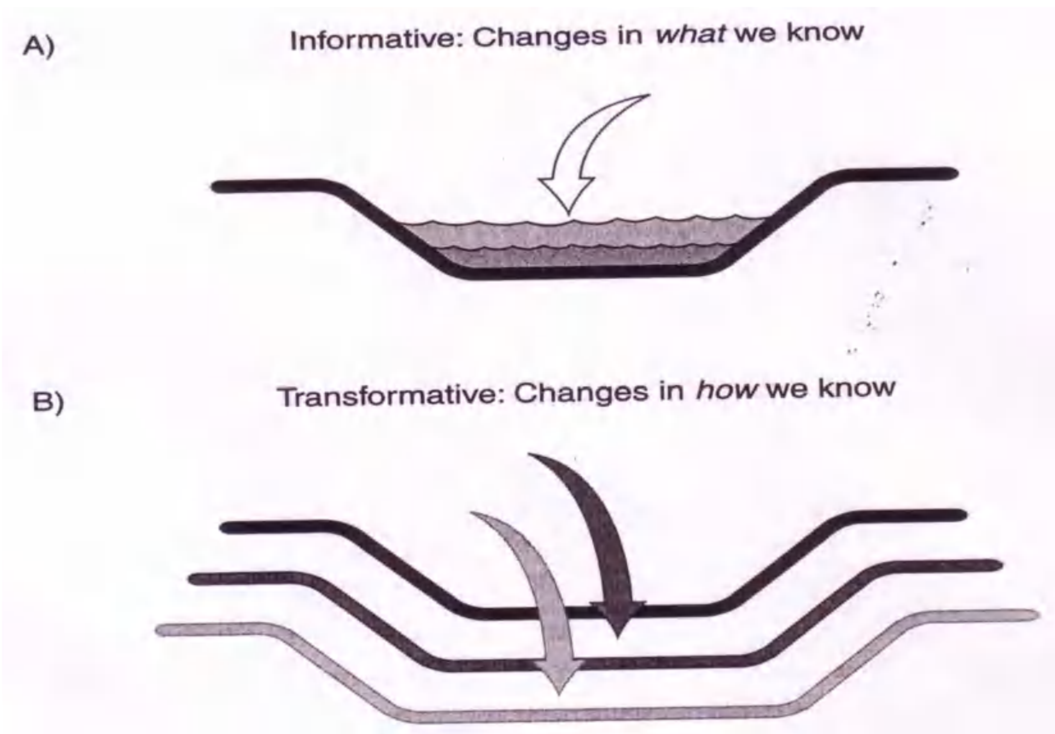
When transformative learning occurs, we are able to make a frame of reference more dependable because it enables us to better justify our opinions and interpretations when making meanings. Since frames of references are highly individual, transformative learning can be perceived as a way of problem solving where one engages in reframing the problem or redefining it and then engaging in critical reflection of the underlying assumptions. Any new perspective, however, does need to be justified through discourse with others. Critical reflection may engage us in questioning the content, process, premises or underlying assumptions, etc. For example, in our context, we could question whether we have assigned reasonable performance indicators for particular academic tasks to be performed by students. Are they fair, representative? Critical reflection involves reasoning and intuition rather than assimilating mindlessly. Cohen (1997) described a student transformation in which a student had negative learning experiences but, through a series of transformational learning events, became more secure as a learner, moving from that insecurity to "I can understand…" and "I am a smart, competent person…" – a habit of mind. When we try on another's point of view, we change our own.

Kegan offers a constructivist approach to transformative learning:

1. Transformational kinds of learning need to be more clearly distinguished from informational kinds of learning, and each needs to be recognized as valuable in any learning activity, discipline, or field.
2. The form that is undergoing transformation needs to be better understood; if there is no form, there is no transformation.
3. At the heart of a form is a way of knowing (frame of reference); thus genuinely transformational learning is always to some extent an epistemological change rather than merely a change in behavioral repertoire or an increase in the quantity or fund of knowledge.
4. Even as the concept of transformational learning needs to be narrowed by focusing more explicitly on the epistemological, it needs to be broadened to include the whole life span; transformational learning is not the province of adulthood or adult education alone.

5. Adult educators with an interest in transformational learning may need a better understanding of their students' current epistemologies so as not to create learning designs that unwittingly presuppose the very capacities in the students their designs might seek to promote.
6. Adult educators may better discern the nature of learners' particular needs for transformational learning by better understanding not only their students' present epistemologies but the epistemological complexity of the present learning challenges they face in their lives. (as cited in Mezirow, 2005, p. 47)

Figure A.6.13: Two Kinds of Learning: Informative and Transformative



(Mezirow et al., 2000, p. 50)

Epistemology refers to "not what we know but our way of knowing”:

- “meaning forming" – the activity by which we shape a coherent meaning out of the raw material of our outer and inner experiencing. Constructivism recognizes that reality does not happen preformed and waiting for us merely to copy…Our perceiving is simultaneously an act of conceiving, of interpreting. ..Our experience is less what happens to us and more what we make of what happens to us.
- “reforming our meaning –forming” – a metaprocess that affects the very terms of our meaning-constructing. We do not only form meaning, and we do not only change our meanings; we change the very form by which we are making our meanings. We change our epistemologies. (Kegan, as cited in Mezirow, 2005, p. 52)

Therefore, “transformational learning supports changes in a learner's form of knowing,…the psychological process of transformations in our knowing” (p. 53). Other authors provide a deeper look at transformative learning from various critical and analytical perspectives – well worth the reading. Let us end with the distinction between transformative learning and critical reflection. Brookfield (1987) defines the relationship between the two: critical reflection is integral to transformative learning. Transformative learning cannot happen without critical reflection at every stage, but they are not synonyms for each other. Just because critical reflection occurs, does not mean that transformative learning ensues. If questioned assumptions remain the same after critical reflection, then perhaps transformative learning has not been achieved. And beyond that, there should be a result of transformative actions. "Deciding" can be an action in transformative learning (as cited in Mezirow, 2005, p. 141). Taylor presents a study of transformation and identifies the dimensions from the learner's perspective. The five dimensions are 1) Toward Knowing as a Dialogical Process; 2) Toward a Dialogical Relationship with Oneself; 3) Toward Being a Continuous Learner; 4) Toward Self Agency and Self Authorship; and 5) Toward Connection with Others. Brookfield further defines each one. These enlighten us as to how to teach with developmental intentions. This is adult learning focused. Cranton (as cited in Mezirow) discusses individual differences, transformative learning and the educator's roles: 1) "a responsibility to assist learners in becoming aware of their psychological preferences"; 2)"encouraging critical questioning of psychological habits of mind and supporting the differentiation of the individual from the collective"; and 3) “educators need to help create learning experiences that involve learners of different predispositions in that process" (p. 195). Yes! This is what professional teachers or leaders of learning are to strive to do.

Critical Thinking (CT) and Critical Reflection (CR)

Many authors, (especially in the 1980s) have considered critical thinking and how to develop students' ability to think more critically so learning is achieved at higher cognitive levels and understanding deepens and broadens (Bowell & Kemp, 2005; Browne and Keeley, 1986; Dauer, 1989; Meyers, 1986; Nosich, 2005; Vaughn, 2005 and others). Definitions by leading researchers include

- Critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do. (Ennis, 1987)
- Critical thinking is skillful, responsible thinking that is conducive to good judgment because it is sensitive to context, relies on criteria, and is self-correcting. (Lipman, 1995)
- Critical thinking is thinking about your thinking, while you're thinking, in order to make your thinking better. (Paul, 1992)

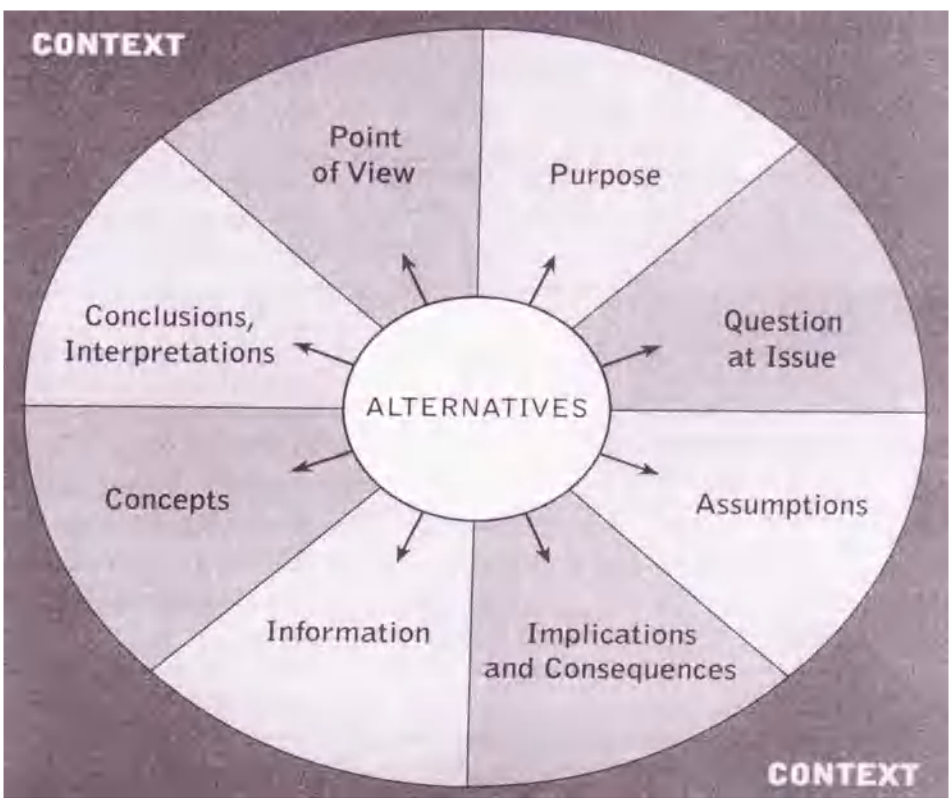
So, critical thinking is reflective and involves standards and being responsible. Three parts of CR are that it involves asking questions, reasoning out the answers, and ultimately believing the results of our reasoning. One must develop the abilities to ask the right questions and reason, but in considering the belief aspect, there are four indicators of when we do not believe the results of our reasoning:

- I reason something out, but strong emotions arise within me against the result.
- I find myself believing contradictory things.
- I believe something very strongly, but I find I am unable to come up with good reasons for the belief. In fact, I don’t' think I even need reasons. Thinking the opposite seems ridiculous.
- I reason something out, but my actions do not follow my reasoning. (Nosich, 2005, p. 11)

Critical thinking is not:

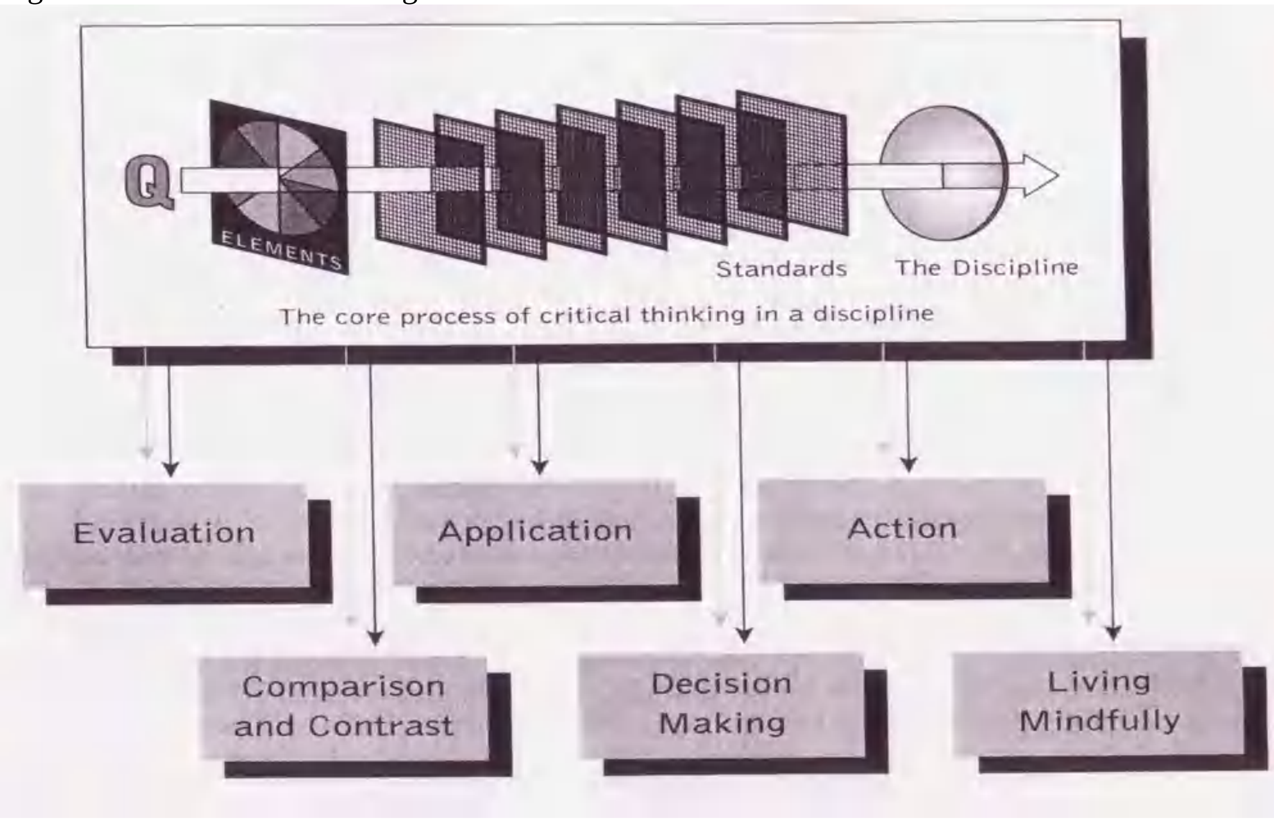
1. negative - although often perceived "being critical" means being negative. In CR, it has no negative meaning at all. It is related to "criteria…thinking that meets high criteria of reasonableness…to learn to think things through, and to think them through well: accurately, clearly, sufficiently, reasonably…effective thinking…[it] does not involve making judgments…[T]o be judgmental is certainly not to be a critical thinker."
2. emotionless thinking - some emotions can impair critical thinking, e.g. rage, panic; others, however, help, e.g. love of truth, joy of discover, anger at biased interpretations, fear of making an unreasonable decision when something is important. Emotions are essential in that they can give us data…[It] often would be foolhardy to ignore the data from emotions; also, being logical is linked to having feeling. (Nosich, 2005, p. 13)

Figure A.6.14: The Circle of Elements



(Nosich, 2005, p. 13)

Figure A.6.15: Critical Thinking Process



(Nosich, 2005, p. 14)

Critical thinking goes beyond problem solving, but involves it. Asking questions is fundamental to CR. One needs to know when a question should be asked or be able to identify when a problem needs to be solved, which takes skill. CR begins with posing the problem. Impediments to CR are

1. Forming a picture of the world on the basis of news
2. Forming a picture of the world on the basis of movies, TV, advertising, magazines
3. All-or-nothing thinking (black-or-white thinking); Us-versus-them thinking, Stereotyping
4. Fears
5. Some educational practices discourage CR
    a. Student role is passive recipient of knowledge
    b. Student role is to memorize and regurgitate information
    c. Teacher's role is to dispense information
    d. Questions on exams should be taken only from what is covered in class
    e. Problems assigned to students should always be clearly formulated
    f. There is an adequate answer to every question
    g. Everything is just a matter of opinion
6. Egocentrism stands in the way of empathy; causes us to make judgments based upon self-interests; makes it difficult to determine accuracy from

inaccuracy; makes one misunderstand other people's motives as well as our own. For teachers, it can lead to seeing education in terms of grades only, missing other benefits of education

7. Developmental patterns of thinking - assumptions one makes and lives by, e.g. previous commitments, previous personal experience-the ability to think in an unbiased way, using evidence, rather than basing views upon past experiences and interpreting only in that light rather than the new evidence or context. Not being ruled by predispositions. (Nosich, 2005, p. 23) (source)

Nosich (2005) leads one through an understanding of the need for CR, its versatility, and its value to all levels of thinking. He offers a model that provides the elements of reasoning, the standards of reasoning, and considers the fields where CR takes place. It is a great resource for our endeavor.

Bowell and Kemp (2005) explore CR, addressing why we need to become critical thinkers and implications for our students. They discuss the role of logic as deductive validity and inductively as a force and thoroughly address the construction/reconstruction of argument, wrapping with "truth, knowledge, and belief," tying into Nosich (2005) above. Their address is more technical but serves as a good resource in that vein.

To continue from the perspectives of others – critical thinking is how someone thinks, what causes a belief, and how one engages in determining the value of a belief. It is “the systematic evaluation or formulation of beliefs, or statements, by rational standards" and involves logic, "the study of good reasoning, or inference, and the rules that govern it" (Bowell & Kemp, 2005, p. 7). However, critical thinking involves more than logic; it also involves establishing the truth or falsity of beliefs, the evaluation of arguments, evolving evidence through analysis and investigation. Critical thinking skills can lead one to new knowledge, deepen understanding, and more importantly empower an individual. It is a prerequisite for enabling students to engage in problem solving, active learning, and intelligent self-improvement or intellectual growth. It is important because it guides our actions. It is "thinking outside the box." Critical thinking requires skills in argument, reasoning, and inferencing. Arguments are a statement or statements supposedly providing reasons for accepting another statement…the main focus of critical thinking. Those reasons are known as "premises." Therefore, arguments are "a group of statements in which some of them (the premises) are intended to support another of them (the conclusion)” (Vaugh, 2005, p. 4).

Meyers (1986) departs from traditional perspectives and posits that critical thinking is different across disciplines. While acknowledging that most definitions are usually based upon formal or informal logic or problem solving skills, these perspectives, he feels, have limitations that do not transfer to other contexts: for example, the rules of formal logic will not apply to an analysis of a Picasso painting or novel. Also the logic and problem solving approaches imply that there is always a problem and solution. Meyers feels the theory suggests that once logic and problem solving skills are mastered, then students can easily apply them across disciplines, but there is no assurance of that across disciplines. Finally, he feels that one of the serious difficulties with the logic and problem solving

approach to critical thinking is that of "passing the buck"; in other words, if students can be "channeled into courses in logic or problem solving, other teachers can relax because the difficult job of teaching students how to think will be done elsewhere" (p. 9). Instead he believes all teachers have the responsibility and play an essential role in the development of students' critical thinking, each from his/her own discipline's perspective. Students need to be challenged to practice critical and analytical thinking across contexts and all disciplines studied (p. 9).

In synchrony with the discussion above on critical reflection, Meyers (1986) mentions Dewey's ([1910], 1982) definition or essence of critical thinking as "suspended judgment," or healthy skepticism. .. the qualities of 'reflective thought' that might also be said to characterize critical thinking…Active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it…constitutes reflective thought" ([p.7] p.8). Loacker et al. (1984) went on to describe it as an experience in which students "questions, examine, prod, poke, dissect, and explicate" (p.3). This process requires that students struggle with problems and issues and, important to note, that they see their professors doing the same. Also interesting to note is that the authors feel that if students engage in the rediscovery of what is already known, they will have little motivation for critical analysis. They suggest that college professors create classrooms where there is an atmosphere that encourages natural inquisitiveness. "Humans are born smart…all we have to do is to stop doing things that make them stupid" (Holt, 1982, p. 161). This means interactive classrooms, where the students are not sponges for lectures and where students can engage in the subject matter and practice the art of critical thinking. An analogy presented was the idea of a college course in basketball where students learn terminology, diagram plays, and watch videos; then for the final exam, they are expected to play a competent game. They make the point that this is what is expected when professors present lectures on theory, test for recall, and then expect students to demonstrate good critical thinking skills on the final project. It does not “play” out that way.

> In traditional teaching there is often an implicit assumption that learning to think critically develops naturally as students learn increasingly complex levels of a discipline content and information. While there may be a natural basis for human inquisitiveness, there is nothing natural about learning a framework for analyzing a modern novel or management system. Analytical frameworks must be taught explicitly and constructed consciously, beginning with simple operations and building toward complexity and subtlety. Initially, for most students, this means learning to recognize key concepts, terms, issues, and methodologies – not by memorizing them but by working with them in the context of real problems and concerns and by relating them to experiences and previous learning. (Meyers, 1986, p. 10)

Meyers (1986) goes on to discuss student interest and motivation, including barriers to student interest. He discusses how students create meaning in their own terminology and encourages the use of analogies and metaphors. He discusses structuring classes to promote critical thought by balancing content and process, stating that when using textbooks, instructors feel obliged to complete the entire text at the expense of process.

This has real meaning for our initiative. We are firmly committed to changing the process models so that does not happen. He confirms that it is important to begin with "what do you want students to know and be able to do" (p. 55), which makes it possible to determine what is essential to cover in the course. (Our professors completed a thorough analysis process to do exactly that.) Meyers goes on to describe the importance of balancing lecture and interaction, relying on Piaget's learning theory on "social transmission in the development of new mental structures" (p.56) and on Lawson and Renner (1975).

> In order for the learner to be shaken from his egocentric views, he must experience the viewpoints and thoughts of others…If he does not, he has no reason to alter the mental structures that he initially acquired from his self-centered frame of reference. Social interactions can lead to conflict, debate, shared data, and the clear delineation and expression of ideas. (p. 338)

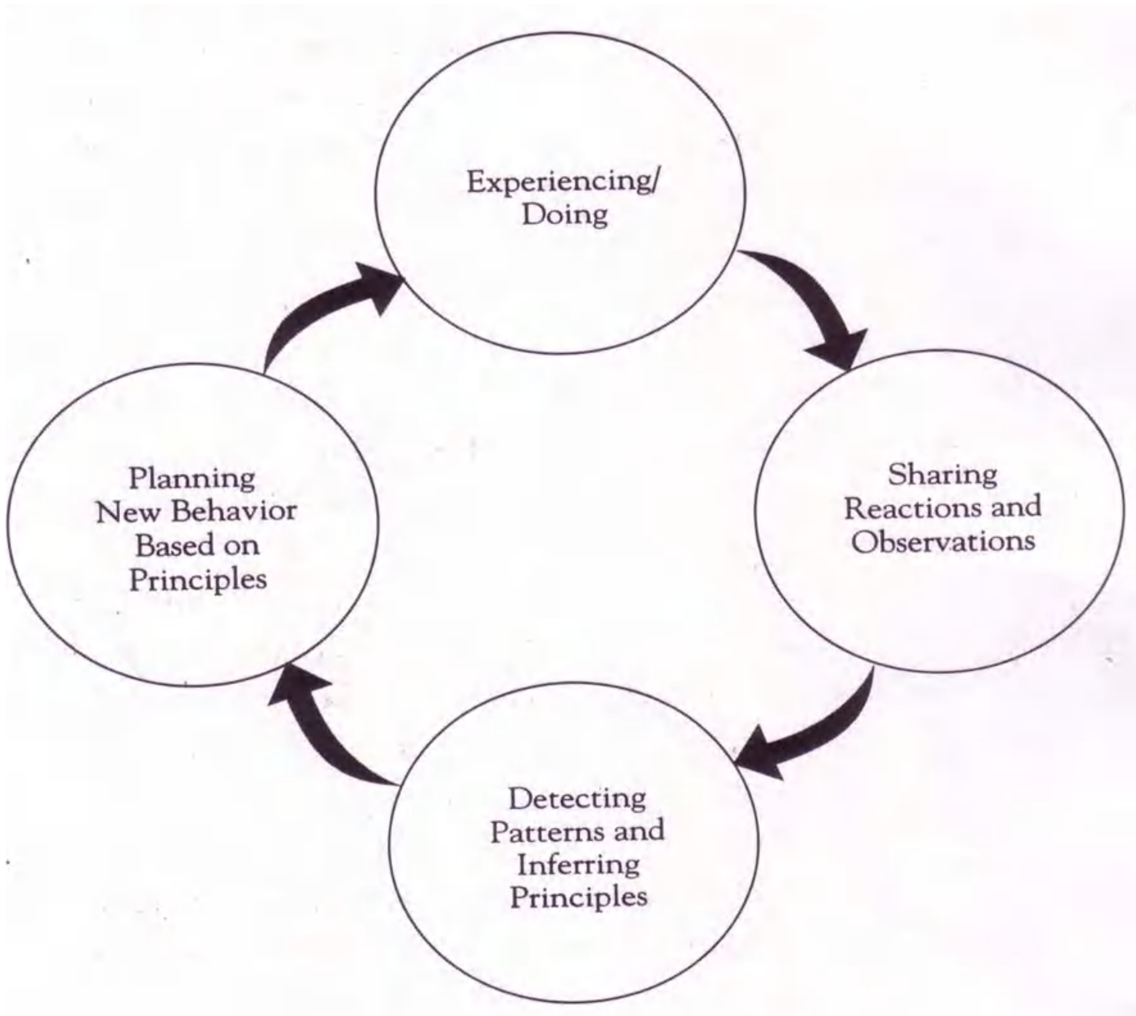
These authors, along with Piaget (1976) and Kohlberg, strongly believe that active forms of learning are more effective than lecture to stimulate cognitive and ethical development in students. This does not eliminate lecture but puts it in its proper place. In my opinion, it repositions the burden of learning to students – back where it belongs. Yes, professors are responsible for their own learning, but the burden of learning for students should lie with students. Lectures are good to stimulate interest, explain a concept or theory, raise questions, present problems, provide information not available in other forms, clarify concepts through analogies or examples, summarize, but not as used by many professors. It does not allow for interaction by the students and does not lend itself to information processing, especially transformative learning as described above.

Meyers (1986) goes as far as to present room organization to better provide the opportunity for critical thinking. This has always been one of my strategies. I have never used the standard classroom layout and have often been criticized, and even reprimanded, for changing the room organization. In fact, interesting to note, is that when our new off-campus centers were relatively recently built, many of the rooms had tables bolted to the floor. When I asked for round tables or tables that could be moved into circles, the administrative directors went ballistic! They only had round tables in the lunchroom, and they did not want to move tables in the other rooms. For those who know me, they already realize that my persistence paid off, and now I am able to command the type of arrangement I need to accomplish interactive learning. However, many would not feel as comfortable being that persistent. Humorous to note is that when business and industry, those who rent the rooms in our centers, began to request round tables, there was a shift in thought that benefited me. The importance of this is that our institutions often are not up to date on the better teaching space designs, thus making it difficult for us to change, even when we are inclined to move towards a more interactive teaching and learning environment. Finally, Meyers goes on to discuss other ways to support engaging students in critical thinking and justifies why critical thinking should be part of every course a student takes.

Experiential Learning

The segue into problem-based learning from the topic of critical thinking might be considered experiential learning. Farquharson (1995) describes Kolb's (1984) model as a cycle of experiencing/doing, sharing reactions and observations, detecting patterns and inferring principles, and finally, planning new behavior based on principles.

Figure A.6.16 : The Cycle of Experimental Learning



(Farquharson, 1995, p. 107)

Clearly this model presents the opportunity to visualize the way in which critical thinking can be used while engaged in active learning. The model supports active learning and learning by doing. In planning experiential learning, it is important to give equal weight or attention to each aspect of the cycle. The experience is the "means to the end," not the end in itself. Therefore, outlining the stages of the experience will enhance understanding of what is expected. The sharing and observations component provides the opportunity

for students to make meaning and clarify their understanding. Moving into more sophisticated learning, the next stage of detecting patterns and inferring principles connects data and principles more deeply, constructing meanings when determining what and why something took place. Students can then generate principles for future action based upon what they have learned; thus, they enter into the planning of new behaviors or actions based upon the principles. They take robust theories and plan new activities to engage in validity checks of principles derived from theories. This is all highly oriented toward critical thinking. To accomplish well designed experiential learning, students must engage in critical thinking. Questions can be important elements to facilitate inquiry. Practitioners, faculty, and students need to learn to effectively frame questions, and to know how to determine the right questions. Emancipatory learning "is the practitioner's skill in engaging learning in question posing and question framing" (Farquharson, 1995, p.162; see also Brookfield, 1987; Kurfiss, 1988; Long, Paradis, & Long, 1981; Meyers, 1986; Mezirow, 1990, 1991; Paul, 1992). Useful questions and higher order questions that promote synthesis and evaluation are important. Farquharson proposes the following approach to guide the process:

- Cognitive questions: Use to check that learners understand basic information. Example: What are the five elements of the EDICT model?
- Convergent questions: Use to relate, compare, and combine information. Example: How does the EDICT model compare with Kolb's stages of learning cycle?
- Divergent questions: Use to apply knowledge creatively Example: How could you use the EDICT model to design a unit of instruction on basic budgeting?
- Evaluative questions: Use to assess values and judgments. Example: What are the strengths and limitations of using the EDICT approach for planning? (p. 163)

Paul (1992), director of the Center for Critical Thinking at Sonoma State University, says: "Critical thinking is that mode of thinking, about any subject, content or problem, in which the thinker improves that quality of his or her thinking by skillfully taking charge of the structures inherent in thinking and imposing intellectual standards upon them" (p. 4). This puts the focus on logical reasoning abilities. Habermas (1979) thinks that critical dialogue has power relationships that need to be taken into account, and he calls the way statements are justified by those in power emancipatory learning rather than critical thinking. Mezirow (1991) derives his transformative learning from Habermas, and he states: "Emancipatory education is about more than becoming aware of one's awareness. Its goal is to help learners move from a simple awareness of their experiencing to an awareness of the conditions of their experiencing…and beyond this to an awareness of the reasons why they experience as they do and to actions based on these insights" (p. 179). This requires the critical reflection we have mentioned so often. Farquharson (1995) suggests that when considering a teaching intervention that one engages in two different types of checks: "1) ensure that the design has taken into account some of Knowle's (1985) principles and 2) verify that the design has included some of Wlodkowski's (1991) ideas about ways to gain and sustain learners' attention and motivation to learn." Therefore, Farquharson asks the following questions:

- <u>Learners' Self Concepts</u>
  1. Is the plan free of factors that might make the learner feel threatened or inadequate?
  2. Does the assessment of the entry-level knowledge and skill of the learners seem reasonably well founded?
- <u>Learners' prior experience</u>
  1. Is there a way to check out what learners already know about the materials to be learned so the teacher can create ways to graft the new learning onto metaphors drawn from learners' prior experience?
  2. Does the design effectively draw out prior experiences that may contribute to learning the new material?
  3. Are there opportunities and structures that will encourage synergistic learning among the members of the learning group?
- <u>Learners' readiness to learn</u>
  1. Is this the moment when the learners are ready to explore this material, and if not, what steps can be taken to enhance their readiness to learn?
  2. Why would these learners want to learn this material at this time?
  3. Given the assessed motivation of the learners, is the amount of material appropriate or is there a danger of teaching them more than they would ever want to know about the topic?
  4. Would there be any value in delaying this teaching intervention until a more potent "teachable moment" presents itself?
- <u>Life centered or Problem centered relevance and application of the material</u>
  1. Is there an element in the design that will let the practitioner know very early in the learning process what particular applications individual learners have in mind for the material they are learning?
  2. Are there formative evaluation systems in place that will keep the practitioner aware of the way in which learners construct meaning?
  3. How are learners applying what they are learning? (pp. 166-168)

Wlodkowski's (1991) ideas about ways to gain and sustain learners' motivation to learn are offered through 68 practical strategies and the following questions for considering the teaching/learning design:

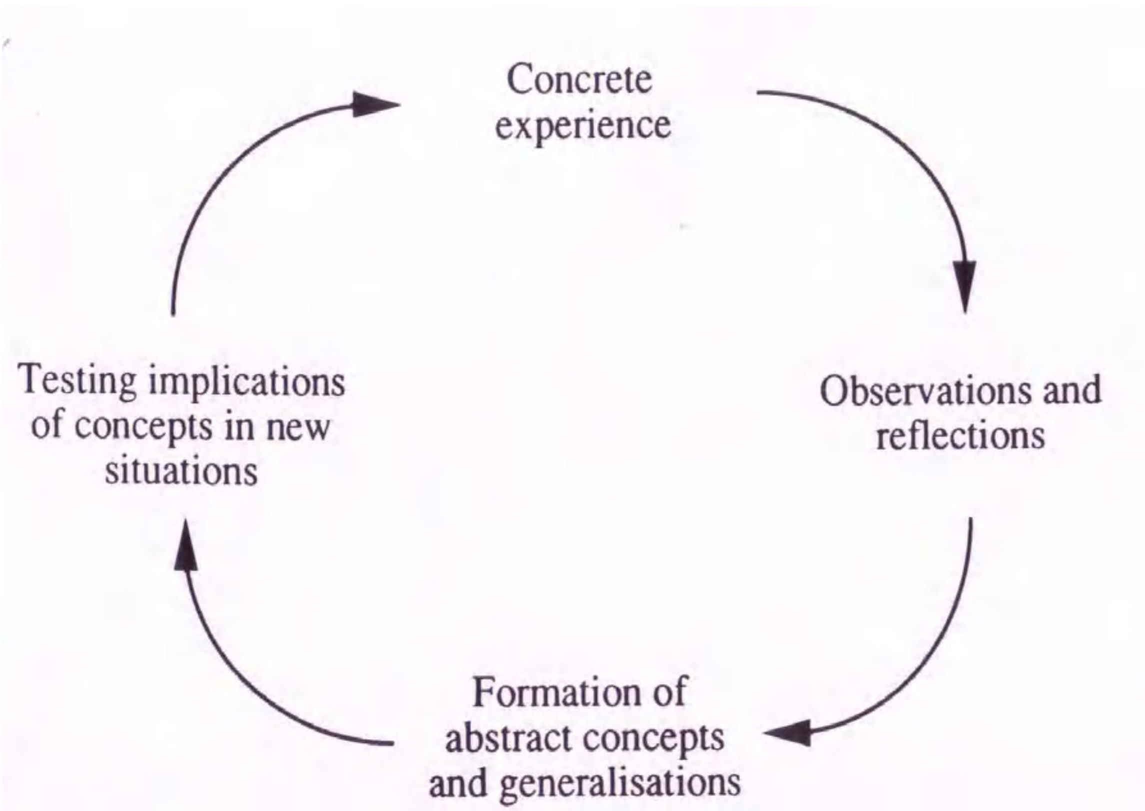
1. What has been done to foster a positive attitude for this experience?
2. Does the plan address the felt needs of the learners?
3. What will stimulate and sustain learner motivation during the event?
4. What has been done to maintain a positive climate for learning?
5. Does the even increase and sustain the learner's sense of competence?
6. How will the learning continue to be reinforced in the future? (p. 258)

When considering learners versus students, Farquharson (1995, p. 179) provides the following role descriptions:

Learners	Students
Creative	Obedient
Powerful	Parroting
Curious	Obsequious
Interesting	Poverty-stricken
Risk takers	Overloaded
Intuitive	Mind readers
Involved	

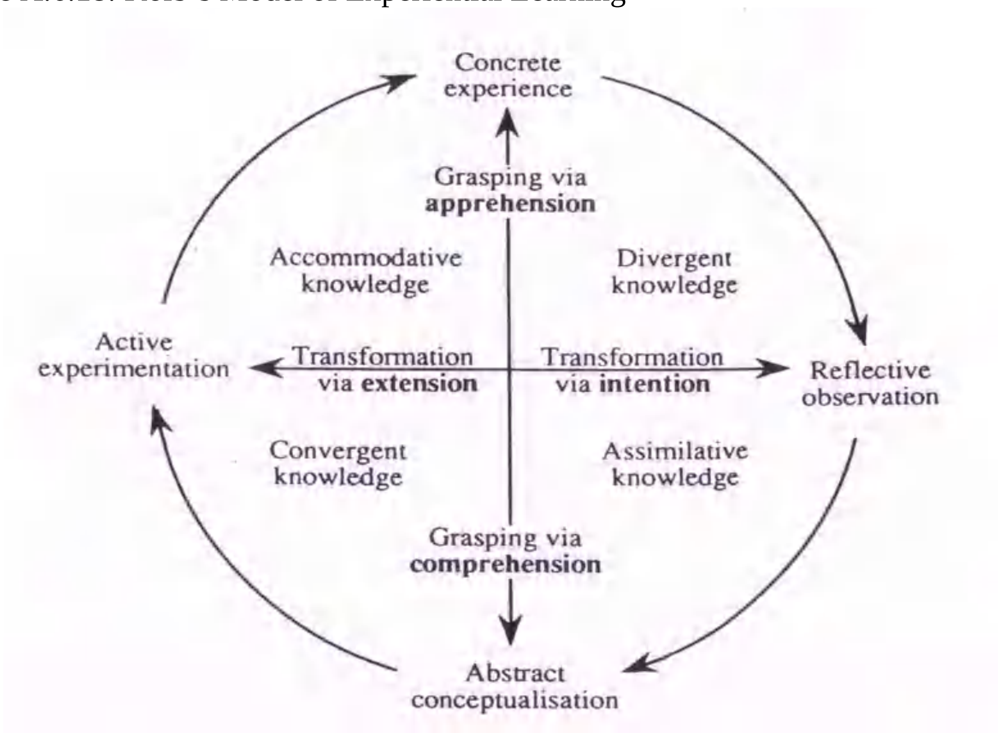
Our goal is to engage students as learners rather than as merely students.

Figure A.6.17: The Lewinian Experiential Learning Model



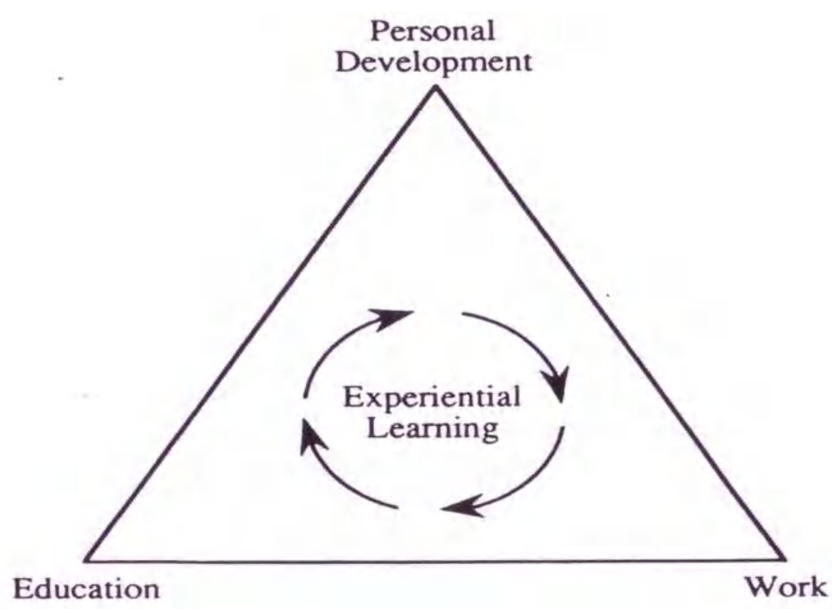
(Kolb, 1984, p. 21)

Figure A.6.18: Kolb's Model of Experiential Learning



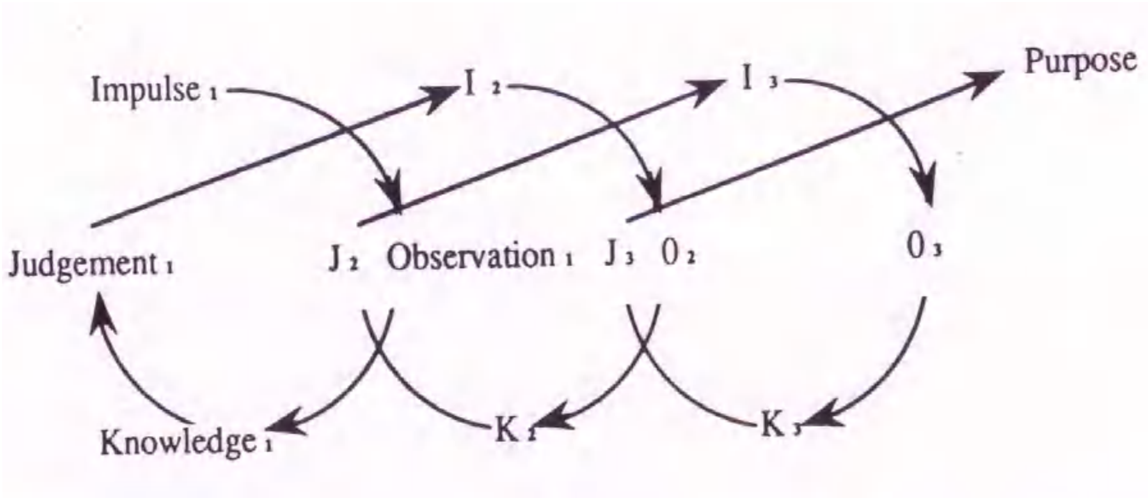
(Kolb, 1984, p. 42)

Figure A.6.19: Experiential Learning as the Process That Links Education Work and Personal Development



(Kolb, 1984, p. 4)

Figure A.6.20: Dewey's Model of Experiential Learning



(Kolb, 1984, p. 23)

Problem-based learning (PBL) in HE - Learning With Complexity

There are a good number of sources available on problem-based learning; however, I will focus on one primary one, as it does an excellent job of justifying, exploring, and explaining high quality problem-based learning. The academic beauty of problem-based learning should be that there is more than one solution to any problem and that students are strongly encouraged to create and provide argument for their particular solution. This stimulates and challenges them to go beyond what they might have considered if solution justification was not part of the requirement. However, students really respond to the challenge and enjoy challenging professors and each other. If the problems are quality problems with quality criteria (rubrics) to guide their responses, the outcomes are usually high quality. Problem-based learning also teaches students to value their own perspectives and voices; however, problem-based learning can take some adjustment for some students who have been immersed in lecture-based courses. Students may initially find it difficult, more complex, and that the level of effort and work on their part is much greater; thus, they may resist at first. But once fully engaged, most students are "converted" and eagerly participate. Problem-based learning demands a greater understanding of the knowledge. Its solutions take research, options must be explored, and students must develop an ability to critique information and alternative solutions. Students must be able to engage in analysis, justification, and reasoning. If problems are well designed, they are complex. Required performance tasks, across a wide range of knowledge areas and skills, are nested within the problem. Students engage with complexity and ambiguities become evident. Most importantly, students are required to integrate knowledge and skills from across disciplines and subjects.

Professors, however, must reposition themselves related to teaching. Using problem-based learning is more complex but equally more rewarding and changes the entire teaching-learning context. Professors have to re-orient their position with students. They are no longer the primary knowledge broker. Textbooks are no longer the primary source

and should not have been anyway. Students become a primary source, and if accomplished well, students challenge the perspectives and experience of the professor. I have found this to be personally rewarding. When students come to me and question my knowledge, directions, suggestions, and, yes – even requirements, if I cannot justify my perspective or requirement, then it probably is not a good one! The learning environment where problems are the center and source of learning is without doubt the more exciting, stimulating, and rewarding teaching environment. However, it is work, and the professor must prepare for it. Those professors who have the interests of the student at the core of their ethics and practice and those that want to continuously raise the learning bar for themselves and their students find that their rewards are so integrally entwined with the success of their students that they thrive as well. Problem-based learning is a method that works to "make sense" of learning or "create meaning" (Savin-Badin, 2000).

Savin-Baden (2000) feels that although it (PBL) has been an approach to learning since the 1960-70s, it has yet to be fully realized to achieve its full potential in learning environments. The author makes a distinction between problem-based learning and problem solving learning. Problem solving learning has been used for years. This is when professors give a lecture and then provide a set of questions. Students are to find the solutions. Sometimes problem scenarios are used, but usually within a discrete subject area. Students are sometimes trained in problem solving techniques, but just as often not. The learning focus is on finding answers, with the answers usually in the information. The solutions are "bounded" and considered vital, with usually no requirement to go beyond those materials. Problem-based learning is different. Curricular content is organized around the problem scenarios rather than subjects or disciplines. Students work in teams or groups, and there are no predetermined "right" answers. The situation presented is complex, and students are expected to engage by determining what information they feel is needed and what they must learn or what skills they need to gain to effectively solve the problem (or in a complex scenario, problems). Problem-based learning is much more student centered; problem solving learning is still more teacher or professor centered. Problem-based learning provides the context in which students explore a wider range of knowledge and skills or information. They engage in linking learning with their needs to solve the problem(s) and in independent inquiry. Problem-based learning requires flexibility and diversity, in that learning can be characterized differently and implemented through a variety of methods and processes. It requires the integration of knowledge and skills, disciplines and subjects, and the use of a wider range of tools and techniques. The focus of learning is the problem scenarios, not discrete disciplines or subjects. Personally, I like to engage teams within the same course in different problem scenarios so they are learning what has been deemed as critical, using different "vehicles" to do so, instead of all working on the same problem. This taps into student interest and decision making, truly empowering them by giving authority. In my opinion, this is also a way for students to develop new and use existing "common" knowledge. More importantly, it is a great method that not only provides the opportunity, it requires that "uncommon" knowledge (knowledge that is specific to each individual student that others with them do not know) comes into play, thus broadening what all learn using each other as knowledge and skill resources. This is critical to a team environment because there is no need for a team unless it has a diverse range of

knowledge and skills. If problems are designed appropriately and well, are appropriately complex, there is a need for both "common" and "uncommon" knowledge as well as the "generation" of knowledge by both individuals and the team as a whole. Team learning is critical.

In this type of learning environment, we are creating student learning communities or a learning community with student learning circles. We are using Senge's (1990) learning organizational theory, mentioned above. Students examine their own knowledge and skills and question each other and their beliefs about their own knowledge in ways that lectures and even the problem solving methods simply cannot accomplish. Dewey (1938) established that learning is not something "reliable and changeless," but rather an

> activity, a process of finding out…that we are the stuff and substance of the world and as such we must work from the middle of a situation in which our most reliable beliefs are at best imperfect inadequate – is that we are not spectators, but agents of change…a pragmatic stance towards knowledge…that knowledge was bound up in activity. (as cited in Savin-Baden, 2000, pp. 2-4)

Scarborough (1983) found that students learned more when engaged in activity rather than just listening, that students performed at a higher level when measured for learning when they (a) listened, (b) listened and watched a demonstration, and then (c) listened, watched a demonstration, and engaged in technical activity. The third method resulted in higher learning levels.

Problem-based learning has some of its justification with the shift from liberal arts education (education for the sake of education) toward the relationship between education and industry, in which a set of professional competencies has become the focus of curricula. This was in some ways contradictory to the type of education needed for students to develop the capacities to operative effectively in society [and at work]; this curricula was termed operational curricula. Problem-based learning bridges the two foci of education and curricula, offering students engagement in education that has real meaning, valuing knowledge both for its own sake and its market context. <u>Learning with complexity</u> is where there are no direct answers to problem scenarios; it is a process that develops the ability to learn as well as solve the problem scenario. Students can link their own interests and perspectives and their own motivations; this occurs in a 'real world' context – the problem scenario and embedded problem(s). The requirements of real world communities of practice can be one foundational component of the problem and scenario. Savin-Baden (2000) bases her argument for problem-based learning in higher education as more central than it currently is on the following themes. (It is important to note that in our engineering and technology context, ABET, the National Science Foundation, and NAIT expect learning to be problem based, not just problem solving.) Themes include

1. Problem-based learning as a concept and approach is often misunderstood…[and] has often been confused with forms of problem solving learning…
2. Misunderstandings…have resulted in an underestimation of its value in terms of equipping students for a complex and changing professional life…
3. There exist a number of forms of problem-based learning…

4. There is, as yet, little known about what actually occurs, as it were, inside problem based curricula in terms of staff's and students' lived experience of the curriculum…Second, key elements such as learning context, learner identify and 'learning in relation' are rarely acknowledged or discussed when implementing or enacting problem-based learning.
5. Learning should be seen as a cyclical process in which students make 'transitions' through which they develop increasing…understandings of themselves, their context, and the ways and situations in which they learn effectively.
6. The full potential of problem-based learning will only be achieved through
   - understanding and acknowledging the similarities and differences between problem-based and problem solving learning
   - making the form of problem-based learning explicit
   - recognizing the impact of the organization upon implementation …
   - acknowledging that problem-based learning can offer…students the opportunity of learning to 'make sense' for themselves, personally, pedagogically and interactionally
   - realizing the value and complexity of it as an approach to learning and the ways in which it can help students to understand and challenge their situations and frameworks by encouraging them to 'learn with complexity' and through ambiguity. (Savin-Baden, 2000, pp. 8-9)

Savin-Baden (2000) thoroughly explores the theory and research bases through which problem-based learning emerged and the arguments related. She especially mentions Bouden’s (1985) characteristics in addition to its student and problem centeredness. Problem-based learning:

1. acknowledges the base of learner experience
2. emphasizes students’ responsibility for their own learning
3. crosses disciplines
4. intertwines theory and practice
5. focuses on processes of acquiring knowledge rather than just the products of such processes
6. changes the professor's role
7. changes the focus of assessment from professor assessing student outcomes of learning to student self and peer assessment
8. requires a focus on communication and interpersonal skills; students must understand those requirements if they are to be capable of relating their knowledge; they need more than their technical skills.

Savin-Baden (2000) also points out Barrows’s (1986) taxonomy of problem-based learning methods, which explains different meanings and uses:

1. <u>Lecture-based cases</u> - students are presented with information through lectures and then case materials are used to demonstrate that information
2. <u>Case-based lectures</u> - students are presented with case histories or vignettes before a lecture that covers the relevant materials

3. Case method - students are given a complete case study that must be researched and prepared for discussion in the next class
4. Modified case-based - students are presented with some information and are asked to decide on the forms of action and decisions they may make. Following their conclusions, they are provided with more information about the case
5. Problem based - students meet with a client in some form of simulated format that allows for free enquiry to take place
6. Closed - loop problem based - an extension of the problem based method, where students are asked to consider the resources they used in the process of problem solving in order to evaluate how they may have reasoned through the problem more effectively.

Problem-based learning is more an educational strategy than a teaching model. There is argument that for problem-based learning to be present, the requirements are

1. curriculum be organized around problems rather than disciplines, with an integrated curriculum and emphasis on cognitive skills
2. conditions facilitate problem-based learning such as small groups and active learning
3. facilitation of outcomes such as the development of lifelong learning skills

Problem-based learning is an excellent stage for students to learn to work in teams and learn as teams, a primary requirement of business and industry today. Students can enter into debate where they learn from each other. Learner identity is a key concept with interaction between the learner and learning, which forms a particular type of identity. This includes but goes beyond learning styles of the learner. Students begin to be aware of how others see them as learners and realize a need to adapt their learning style across different learning contexts. Learner identities evolve as students transcend subjects and disciplines and structures of higher education. Regarding problem-based learning, learners begin to challenge the framework rather than having frameworks imposed upon them. Technology can inhibit the development of learner identity as it can cause a shift back to isolation, individualized and solitary, virtual learning. Heppell and Ramondt (1998) establish that although there is a technological revolution, constructivist models of learning are not yet part of the revolution. Problem-based learning involves the students in "dialogic" learning where understanding emerges from the learning environment; students draw on their own experiences to explain concepts and ideas and then use that to make sense or make meaning (Mezirow, 1981).

Learning in context…

> is broader than students' experiences of the curriculum and teaching methods in which they are engaged, but a conception that acknowledges the values that underpin those structures, the values that [professors] and students bring to that context and the relationships that occur (or fail to occur) between students and between [professors] and students. …also incorporates the way in which the curriculum is situated within the university and the broader framework of HE,…affecting what it means to be a learner in those contexts….[and] not only

> comprises the formal curriculum but also the informal one - the ones the students create for themselves. (p. 35)

We need to keep in mind the difference between transferable skills and the ability to transfer skills. We seek to have students learn and understand that knowledge and skills should be transferable across contexts, but I have never heard anyone mention the issue of the "ability" of transferring knowledge and skills. Bridges (1993) explains that adaptation across contexts requires the use of meta-skills.

> These begin to look like very sophisticated personal/intellectual achievements, which might explain why they are not in abundant supply…they look more like the kind of competence, capability or ability which lies at the heart of the sensitive, responsive and adaptable exercise of professionalism in any sphere than the atomistic list of 'competencies' towards which we are sometimes invited to direct our enthusiasm. (p. 51)

<u>Learning in relation</u>, “students learning with and through others in ways that help to make connections between their lives, with other subjects and disciplines and with personal concerns, offers students particular kinds of learning opportunities" (Weil, 1989 as cited in Savin-Baden, 2000, p. 36). This can occur, for example, incidentally in lectures, group work, discussion, debates, formally and informally as students make an effort to create sense of their learning, their experiences and relationships, and their lives – making connections, developing their own voice, and learning to trust their own voice. Barnett (1994) discusses this as "being released," the idea of developing one's own voice, which goes beyond empowerment and self realization to develop the learners’ identity by constructing and articulating their own perspectives and defending those perspectives before their peers and professors. These three concepts: <u>"learner identity</u>, <u>learning</u> in <u>context</u>, and <u>learning</u> in <u>relation</u>” should establish the expectations and understanding of what it means to learn in higher education if we want to develop questioning practitioners in the professional and very real world. These concepts acknowledge and value the inner world of the learner and bridge the gap between formal and informal learning contexts, resulting in a different kind of student, one who constructs himself and has learned to use his/her voice.

<u>Finding voice</u> means that learners realize learning is more than the accumulation of knowledge or acquisition of competencies. We moved away from these curricular or learning strategies, as there was a shift away from learning methods such as group work and seminars to more individualistic methods toward assessment lending itself to only right and wrong answers with corrective performance practices rather than more challenging frameworks. This process shifted to mass higher education, to students as consumers, and finally toward more technological environments.

This discussion could move on to include <u>"transitional learning</u>," where the student experiences shifts as a result of critical reflection - learning onward to explore the "dimensions of the learner experience," personal stance, pedagogical stance, interactional stance, and the domains of each through which we can trace the learner's development.

Finally, we need to be concerned about the possible occurrence of disjunction, referring "to a sense of fragmentation of part of, or all of the self, characterized by frustration and confusion, and a loss of sense of self…[resulting] in anger, frustration, and a desire for 'right' answers" (Savin-Baden, 2000, p. 87). A summary of problem-based learning models is presented below.

Table A.6.5: Models of Problem-Based Learning

	Model I *PBL for Epistemological Competence*	*Model II* *PBL for Professional Action*	*Model III* *PBL for Interdisciplinary Understanding*	*Model IV* *PBL for Transdisciplinary Learning*	*Model V* *PBL for Critical Contestability*
Knowledge	Propositional	Practical and performative	Propositional, performative and practical	The examining and testing out of given knowledge and frameworks	Contingent, contextual and constructed
Learning	The use and management of a propositional body of knowledge to solve or manage a problem	The outcome-focused acquisition of knowledge and skills for the work place	The synthesis of knowledge with skills across discipline boundaries	Critical thought and decentring oneself from disciplines in order to understand them	A flexible entity that involves interrogation o frameworks
Problem scenario	Limited – solutions already known and are designed to promote cognitive understanding	Focused on a real-life situation that requires an effective practical resolution	Acquiring knowledge to be able to do, therefore centred around knowledge with action	Characterized by resolving and managing dilemmas	Multidimensional, offering students option for alternative ways of knowing and being
Students	Receivers of knowledge who acquire and understand propositional knowledge through problem-solving	Pragmatists inducted into professional cultures who can undertake practical action	Integrators across boundaries	Independent thinkers who take up a critical stance towards learning	Explorers of underlying structures and belief systems
Facilitator	A guide to obtaining the solution and to understanding the correct propositional knowledge	A demonstrator of skills and a guide to 'best practice'	A coordinator of knowledge and skill acquisition across boundaries of both	An orchestrator of opportunities for learning (in its widest sense)	A commentator, a challenger and decode of cultures, disciplines and traditions
Assessment	The testing of a body of knowledge to ensure students have developed epistemological competence	The testing of skills and competencies for the work place supported by a body of knowledge	The examination of skills and knowledge in a context that may have been learned out of context	The opportunity to demonstrate an integrated understanding of skills and personal and propositional knowledge across disciplines	Open-ended and flexibl

(Savin-Baden, 2000, p. 126)

Constructivism

The above topics on knowledge, transformational learning, and problem-based learning lead naturally into exploration of the "construction of knowledge" or constructivism, since each of the discussions holds inherent aspects of constructivist theory. What is it? "Constructing knowledge, not receiving it" (Marlowe & Page, 1998, p. 9).

> I tell you one thing, if you learn it by yourself, if you have to get down and dig for it, it never leaves you. It stays here as long as you live because you had to dig it out of the mud before you learned it. (Norton as cited in Wigginton, 1985, Introduction)

It really means: constructing, inventing, creating, and developing your own knowledge…Receiving it, getting it, and hearing it does not equal learning. Learning in constructivist terms is

- both the process and the result of questioning, interpreting, and analyzing information
- using this information and thinking process to develop, build, and alter our meaning and understanding of concepts and ideas, and,
- integrating current experiences with our past experiences and what we already know about a given subject.

It's about thinking and analyzing…not accumulating and memorizing… Rather, students uncover, discover, and reflect on content and their conceptions of such through inquiry, investigation, research, and analysis in the context of a problem, critical question, issue, or theme…Students gain and are encouraged to develop through these processes the ability to think for themselves, and to think critically; that is, to discriminate between the relevant and the irrelevant, to look at issues from different perspectives, to interpret and analyze written and electronic data [and other engineering data-designs, etc.] and to "detect crap"…It is about understanding and applying, not repeating back…It is about being active, not passive…for as Dewey said, 'There is no such thing as genuine knowledge and fruitful understanding except as offspring of doing.' (Marlowe & Page, 1998, pp. 9-13)

Constructivist learning theorists agree that constructivist learning revolves around these propositions:

- students learn more when they are actively engaged in their own learning
- by investigating and discovering for themselves, by creating and re-creating, and by interacting with the environment, students build their own knowledge structures
- learning actively leads to an ability to think critically and to solve problems
- through an active learning approach, students learn content and process at the same time (Page, 1990)

In summary, educators, philosophers, and psychologists agree that active learning expands the brain (their work is reviewed in Marlowe & Page, 1998). They did not always use the term constructivism; however, their theories of learning engage students in the construction of their own knowledge while mentally active in or on their environment. Also, Marlowe and Page review the research results on the use of active learning methods associated with constructivism. The research, both older and newer, indicates that active learning methods are much superior in achieving results when measuring academic, affective, and skill learning than teacher-centered or dominated methods. For example, the research reveals that active learning and constructivism result in greater exchange of ideas between students. Their participation greatly increases. They learn to develop hypotheses; use, interpret, and apply evidence; and perceive knowledge as more tentative, not as absolute. Students gain in creativity and intelligence, increase language skills, and use math more effectively. Other students reported students were less

bored. When engaging students in cooperative learning alongside constructivism, there was a highly superior level of learning difference with the cooperative learning groups.

Brooks and Brooks (1993) offer a set of descriptors for constructivist teaching behaviors as a framework from which to operate:

1. Constructivist teachers encourage and accept student autonomy and initiative.
2. Constructivist teachers use raw data and primary sources, along with manipulative, interactive, and physical materials.
3. When framing tasks, constructivist teachers use cognitive terminology such as "classify," "analyze," "predict," and "create."
4. Constructivist teachers allow student responses to drive lessons, shift instructional strategies, and alter content.
5. Constructivist teachers inquire about students' understandings of concepts before sharing their own understandings of those concepts.
6. Constructivist teachers encourage students to engage in dialogue, both with the teacher and with one another.
7. Constructive teachers encourage student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other.
8. Constructivist teachers seek elaboration of students' initial responses.
9. Constructivist teachers engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion.
10. Constructivist teachers allow wait time after posing questions.
11. Constructivist teachers provide time for students to construct relationships and create metaphors.
12. Constructivist teachers nurture students' natural curiosity through frequent use of the learning cycle method. (pp. 103-116)

Atkin and Karplus (1962) describe that method as providing students with an open-ended opportunity for students to interact with purposefully selected materials from which students generate questions and hypotheses – known as discovery. Then the teacher introduces the concept introduction to help focus students' questions, to frame lab experiences, etc., and the students engage in concept application (when students work on new problems). This is often in opposition to how curricula, syllabi, or texts are designed, as they usually introduce the concept first, move to application, and discovery takes place afterwards.

Table A.6.6: School Environments

FIGURE 2.1

A Look at School Environments

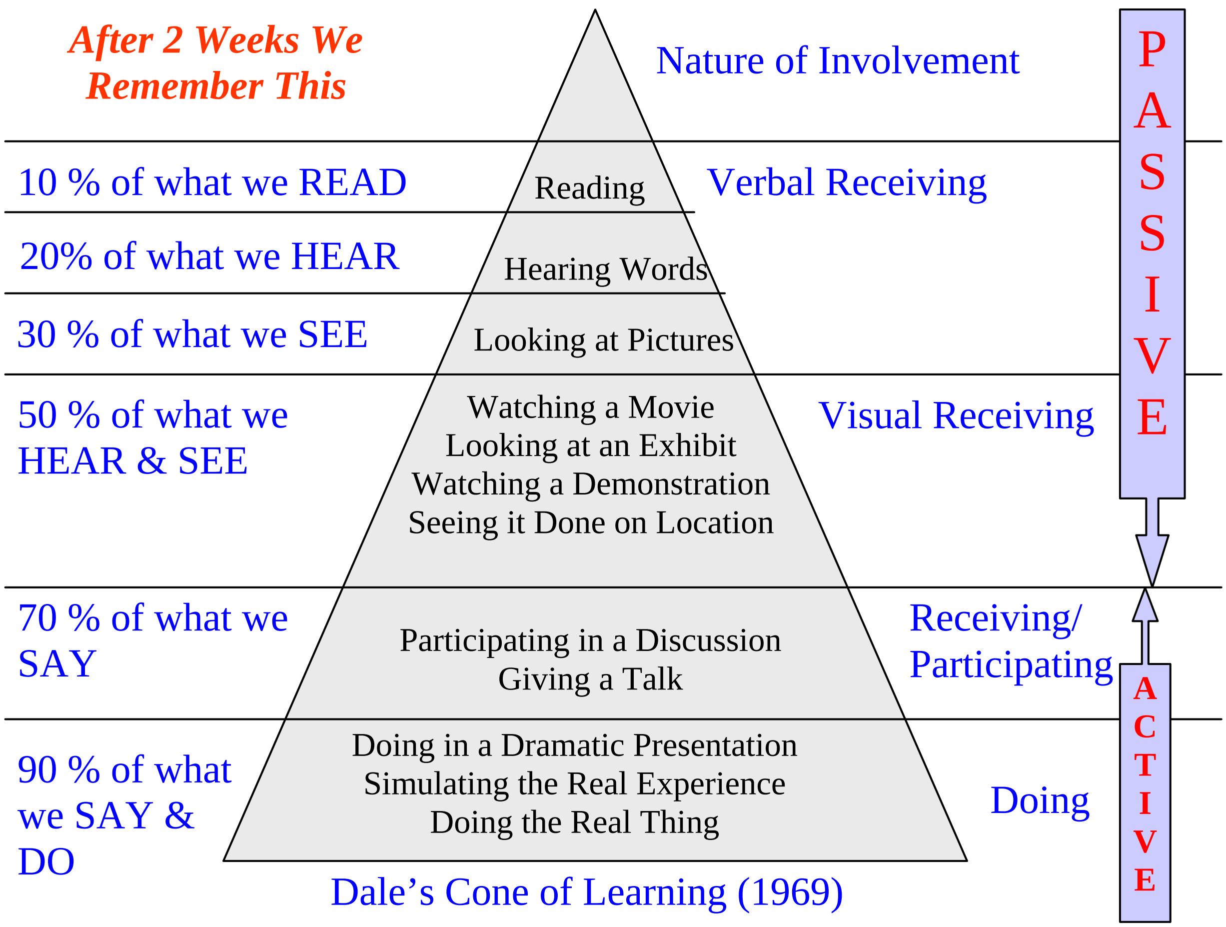
Traditional Classrooms	***Constructivist Classrooms***
Curriculum is presented part to whole, with emphasis on basic skills.	Curriculum is presented whole to part with emphasis on big concepts.
Strict adherence to fixed curriculum is highly valued.	Pursuit of student questions is highly valued.
Curricular activities rely heavily on textbooks and workbooks.	Curricular activities rely heavily on primary sources of data and manipulative materials.
Students are viewed as "blank slates" onto which information is etched by the teacher.	Students are viewed as thinkers with emerging theories about the world.
Teachers generally behave in a didactic manner, disseminating information to students.	Teachers generally behave in an interactive manner, mediating the environment for students.
Teachers seek the correct answer to validate student learning.	Teachers seek the students' points of view in order to understand students' present conceptions for use in subsequent lessons.
Assessment of student learning is viewed as separate from teaching and occurs almost entirely through testing.	Assessment of student learning is interwoven with teaching and occurs through teacher observations of students at work and through student exhibitions and portfolios.
Students primarily work alone.	Students primarily work in groups.

(Brooks & Brooks, 1993)

Active Learning

Much of the above discussion about knowledge, its transformation, learning, critical thinking and constructivism (either directly or indirectly) mentions or includes active learning as a requirement. Meyers and Jones (1993), Twining (1991), and Sutherland and Bonwell (1996) all strongly support active learning strategies. Dale's Cone of Learning (2001) has been a standard or model supporting more active learning and its benefits to learners.

Figure A.6.21: Dale’s Cone of Learning



(Dale, 1969, n.p.)

Passive learning occurs when teachers do most of the work and students are passive most of the time. Conversely, active learning is when students have the opportunity to talk as well as listen, read, write, reflect (research, explore, inquire, design, build, test, analyze, evaluate, and more). Important to note is that students will learn their course content through problem solving and PBL, small group activities, simulations, case studies, and

more – all very active types of learning that engage them in building knowledge and skills. Two assumptions are basic to active learning: "1) that learning is by nature an active endeavor and 2) that different people learn in different ways" (Dale, 2001, p. xi). Teaching corollaries follow: "1) students learn best when applying subject matter, in other words, learning by doing and 2) teachers who rely exclusively on any one teaching approach often fail to get through to significant numbers of students" (p. xi). The result is dissatisfaction on the part of both the teacher and students. Using active learning increases the odds that students leave the classroom with more than notes on facts. (Meyers & Jones, 1993, p. xi). Bransford's (1979) research demonstrated that when information is rehearsed or used to solve problems, students are more likely to retain it. Activity fosters better retention and, more importantly, leads to students' expanding their thinking abilities. The theory behind this is that semantics (memory for facts) and episodic memory (memory for events) interact to bring about long-term memory of what is learned because of the action or active learning through events. This means that teaching and learning become more cooperative in nature and that students have a greater role in learning. Combined with immediate feedback, a characteristic of active learning, students understand their contributions better and see their value. Certainly today, a critical factor is using learning strategies that engage women and a culturally diverse learning group of students. An engineering and technology college such as ours is highly diverse in culture, gender, and ages. Active learning involves students in cooperation where isolation and competitiveness existed before; therefore, the learning environment is appropriate for a wider range of student perspectives and learning strategies. As Pintrich (1988) notes, "little has been done to translate the research on learning and cognition 'into directly applicable information relevant to…classroom practice'" (p. 72). Remember, there is value to lectures, IF they are good and well delivered. Lectures

> dramatize the creation of knowledge…and…interpret knowledge for listeners; students learn from inspired lectures…but a steady diet of lecturing leads to intellectual anemia…lectures are more engaging when …punctual with brief active learning exercises that enhance retention and application…[so students can] use [the knowledge presented] in class and apply it to their everyday lives. (Corder, 1991, p. B2)

The "empty vessel" or "additive theory," where knowledge is imparted to fill the students' vessels or to add to what they might already know does not accurately reflect how students come to us. They come with their own knowledge frameworks, as discussed above. Their perceptual frameworks are very much intact, sometimes even entrenched (the difficult student), and we know from Kolb (1984) and Briggs-Myers (1980) that students learn in different ways. The amount of information and new insights has exploded to further challenge us in our disciplines, leading to the point of view that we simply cannot take the teaching/learning approach that we are passing on a "static" or "known" body of discrete knowledge (also mentioned above). Cross (1991) says: "Learning is not so much an additive process, with new learning simply piling up on top of existing knowledge, as it is an active, dynamic process in which the connections are constantly changing and the structure reformatted" (p. 9). Therefore teaching has and must continue to change…from "transmission" to "dialogue" or "communication"; in other words, from passive to active (Tiberius, 1986). Also Palmer (1987) views teaching

and learning "as a shift in focus from the individual as the 'agent of knowing' to learning as a communal act" (pp. 20). Rather than the more transmissive approach - or transactional approach - where the "ignorant" student is the recipient of the "truth" from the teacher, learning is dynamic and an interchange between the teacher and student, a cooperative of inquiry where a communal dialogue takes place.

Furthermore, Hutchins (1990) feels that what matters “is not just what students know but what they can do with what they know. What's at stake is the capacity to perform, to put what one knows into practice.” This certainly fits into our purpose of performance assessment as a part of that picture. As tests are only indicators of what students might be able to do, a logical part of any student assessment plan should be performance assessment. Teachers are beginning to realize a new role, that of the facilitator of learning, where once again in my opinion, the burden of learning shifts back to the student. We should create opportunities for students not only to construct knowledge as mentioned above, but to give birth to their own ideas, to support student thinking, and to provide the context to deepen their inquiry and thus their understanding (Belenky, et al., 1986). Students should be active in the teaching/learning process. So what really is active learning and how do we begin to transform our teaching strategy from lectures to more active learning strategies? First, let us remind ourselves what lectures do IF well planned, well organized, well delivered, high content quality, and where a pre-organization teaching strategy is used to "set up" for the lecture. This description of a good lecture alone would make many realize that their lectures have not yet achieved this level of quality. However, let us assume for the moment that our lectures are very good. Cashin (1985) feels that they

- Provide information that is new, based on original research, and generally not found in textbooks and other printed sources (not true for those who lecture from their textbooks.
- Highlight similarities and differences between key concepts
- Help communicate the enthusiasm of teachers for their subjects
- Model how a particular discipline deals with questions of evidence, critical analysis, problem solving, and the like
- Dramatize important concepts and share personal insights
- Organize subject matter in a way that is best suited to a particular class and course objectives (p. 10)

One of the primary arguments teachers and professors use as justification for lecturing is that students need some background information, theories, concepts, methods, etc. before they can learn on their own or become active and participants with each other. Or if lectures are not used, students will not have a notebook of concepts, facts, etc. at the end of the course. These are legitimate arguments, but teachers and professors can cover all that content using active learning strategies in complement with or in place of lectures. However, active learning strategies are no more successful than poorly executed lectures if not planned and executed well. One should not consider the choice as either lecture "or" active learning. Usually there is too much lecture, rather than an appropriate amount that leads students into activity oriented learning beyond the lecture. The focus should be to "uncover" the knowledge with our students, provide opportunities for them to dig into

the subject matter to "make sense" of it and to change or expand their knowledge frameworks (Dawkins, 1972). So to consider this seriously, what teachers would rather not know is:

- While teachers are lecturing, students are not attending to what is being said 40% of the time. (Pollio, 1984, p. 11)
- In the first ten minutes of lecture, students retain 70 percent of the information; in the last ten minutes, 20 percent. (McKeachie, 1986, p. 72)
- Students lose their initial interest, and attention levels continue to drop, as a lecture proceeds. (Verner & Dickinson, 1967, pp. 90-91)
- Four months after taking an introductory psychology course, students knew only 8% more than a control group who had never taken the course. (Rickard, Rogers, Ellis, & Beidleman, 1988, pp. 151-152)

Do not throw lectures out totally; use them appropriately with a wider range of teaching and learning strategies. Realize, however, that lectures many consider good are really not good at all, based upon content choice and other factors. Also lecture based courses send the message that we as professors feel we know it all. Of course, we do not and never will. Perhaps we should be more open and honest about that as well. And when professors lecture only from the textbook, then that alone is great evidence that they must not know anything beyond the textbook. Many professors find that active learning strategies are more natural to their own unique styles, personalities, and preferences than lectures, thus their teaching improves because of a better match of strategy and individual. Some struggle with both, and yet others struggle to learn to use active learning strategies comfortably but are glad when they do, as they begin to see changes in their students and learning. Angelo and Cross (1993) offer teaching assessment strategies in their book on assessment. They suggest asking students for feedback on strategies as professors strive to increase their repertoire of strategies. Active learning strategies take more time than lectures; this is also where teachers or professors begin to argue they cannot use them because they will not be able to cover the content. However, as one professor noted, I was not covering the last six chapters very well anyway and students were not doing well on the tested content, so in fact, I was not accomplishing much; therefore, why not use that time for more active learning where students come out knowing and retracting much more.

As a result of active learning, students will begin to cover more content than expected and concepts, theories, and information begin to cluster and take on a life of their own. Sometimes much more will be covered as students engage and seek the information they need to accomplish their learning tasks or activities. Linearity disappears when students begin to “integrate” across knowledge and skills they are learning. Meyers and Jones (1993) make an important statement of belief.

> encouraging students to be self-directed and collaborative, critically reflective, politically savvy, empathic, and fair minded, as well as competent in the skills that are essential to meaningful lives and careers. We are confident that despite their sometimes passive, if not apathetic, exteriors, most students are capable of acquiring those abilities because deep inside remains a desire to explore and to learn. Such students who learn to take responsibility for their own learning will

help make our society more democratic; and a better place for everyone. Finally, active learning helps prepare our students to be self-directed, lifelong learners – an ability they will all need in a society where individuals change jobs numerous times in their working years and have extended leisure time after retirement…We claim no originality here, as the sages and experts we cite and depend on [throughout the book] attest. But we want to be clear that our personal commitment to active learning goes deeper than its efficiency as a teaching tool and that it is essential to our vision of what an educated person should be. ..Those who agree that teaching is more than transmitting information…will agree that making room…for a variety of active learning strategies is a natural step…Those who accept that premise that different students learn in different ways and are frustrated with not teaching their students by traditional teaching will find that active-learning strategies not only enliven their classroom but significantly improve their students' thinking and learning capabilities. (p. 17)

Active learning can be described as three interrelated factors: basic elements, learning strategies, and teaching resources. Basic elements are what students do (e.g., talk and listen, reading, writing, and reflecting). Learning strategies are group work, case studies, etc. Teaching resources are speakers, homework assignments, etc. There can be an interrelationship within the sub factors and also between the primary factors, elements, strategies, and resources.

Figure A.6.22 : Structure of Active Learning

Figure 2.1. Structure of Active Learning.

Elements

talking and listening

writing

reading

reflecting

↓

Learning Strategies

small groups   cooperative work   case studies   simulations

discussion teaching   problem solving   journal writing

↑

Teaching Resources

readings   homework assignments   outside speakers

teaching technology   prepared educational materials   commercial and educational television

(Piaget, 1976, p. 20)

Remember their assumptions: "1) learning is by its very nature an active process and 2) different people learn in different ways" (p. 20). They agree that learners construct their own knowledge, as discussed above, using Piaget's concept of mental structures.

> Children [students] do not receive knowledge passively but rather discover and construct knowledge through activities. As children [students] interact with their psychological and physical environments, they begin to form…structures of thought. These structures help to organize the child's [student's] experience and direct future interactions" (Piaget, 1976, p. 119).

Meyers and Jones (1993) agree with him about a basic principal: "students, no matter what their age, need opportunities to engage in activities – with teachers, fellow students, and materials – that help them create their own mental structures and test them, thus making better sense of the world around them" (p. 21). Therefore, they identify the four key elements of active learning used to create new mental structures as talking and listening, reading, writing, and reflecting. This involves cognitive activities so students will appropriate new knowledge – IF activities are well structured, planned, and guided by teachers. They clearly describe each of these elements and how to do them well, also describing them when poorly executed. The writing section is especially helpful in that they address clarity of instructions. For example, what does a teacher or professor mean when they tell students to analyze something? What does the term "analyze" convey to the student? That certainly depends upon their existing mental structure unless the professor defines it. Meyers and Jones refer to Fulwiler's (1987) help typology of words for written assignments:

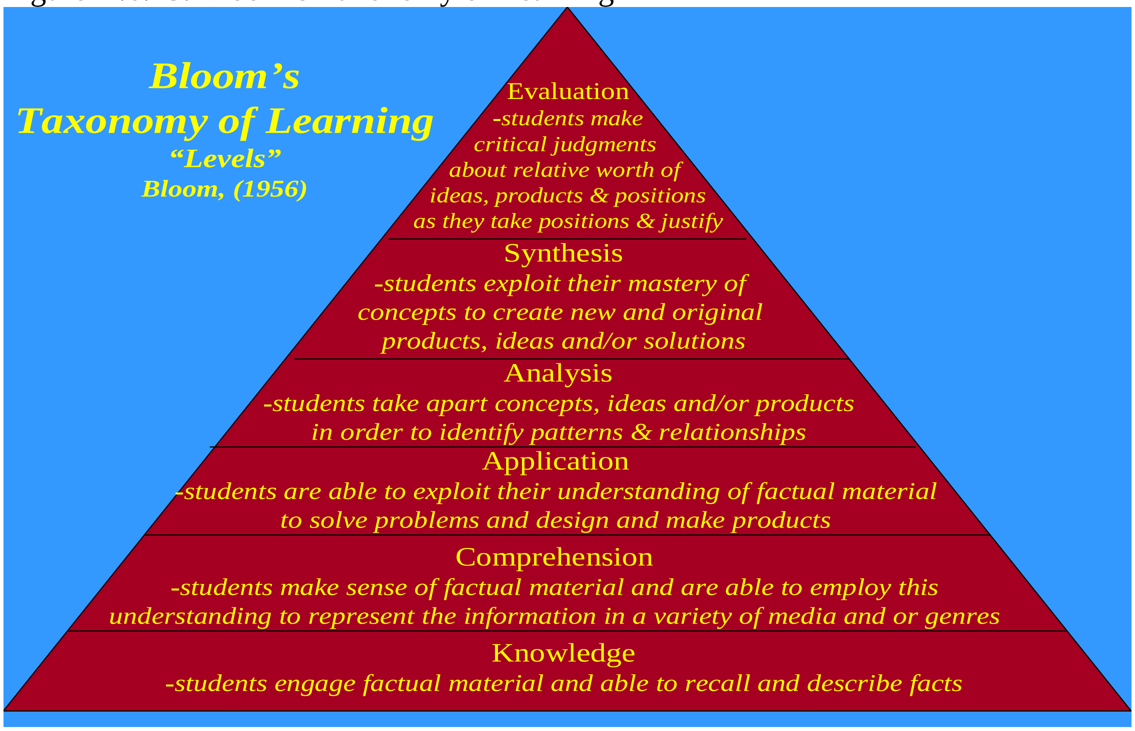
- <u>Analyze</u>: Take apart and look at something closely.
- <u>Compare</u>: Look for similarities and differences; stress similarities.
- <u>Contrast</u>: Look for differences and similarities; stress differences.
- <u>Define</u>: Explain exactly what something means.
- <u>Describe</u>: Show what something looks like, including physical features.
- <u>Evaluate</u>: Make a value judgment according to some criteria (which it would be wise to make clear).
- <u>Justify</u>: Argue in support of something; to find positive reasons.
- <u>Prove</u>: Demonstrate correctness by use of logic, fact, or example.
- <u>Summarize</u>: Pull together the main points.
- <u>Synthesize</u>: Combine or pull together pieces or concepts. (pp. 117-118)

These definitions are especially helpful in consideration of our use of Bloom's Revised Taxonomy of Learning (Anderson & Krathwohl, 2001). They refer to the authors used herein, Mezirow et al. (1990). They also rely on Lawson and Renner's (1975) work mentioned herein on stress disequilibrium and equilibrium as important processes when forming new mental structures. In other words, when knowledge fits into existing mental structures or knowledge frameworks, then there is equilibrium. However, when experiences and new knowledge do not fit with the existing structures or framework, then disequilibrium occurs – a challenging situation where students, or we, must construct new structures or change or expand existing frameworks to incorporate the new knowledge. This requires reflection, or quiet time, so students, or we, can integrate the new knowledge. Thus, it is important to build these reflection times into learning (e.g.,

through silence, journals – for me, concept mapping). Meyers and Jones (1993) go much deeper into the requirements for well designed active learning. They thoroughly discuss the course objectives, syllabus, teaching and learning space, classroom tone (positive), the need to know one's students, and more. These are not new issues for me, as I have mentioned before. To me these topics are often dismissed by teachers or professors; they feel that it is not their responsibility to address much more than the syllabus. I feel much differently. I have seen the climate and environment change the students' responsiveness and desire to be in the course. (More on this later.) They go in depth into several active learning strategies, small group work, cooperative student projects, simulations, case studies, all of which I have used very, very successfully with students. They simply work when well planned and with guided execution. However, there is much to learn about each one. (See these and other authors for details.) In discussing teaching resources, they present print sources and speakers with great detail on what to consider as effective. There is an equally good section on technology (although much has changed since the early nineties), and more reading on selected resources - an annotated bibliography.

Bloom's Taxonomy of Learning.
Sutherland and Bonwell (1996), along with Twining (1991), provide great resources on active learning using Bloom's Taxonomy as a conceptual foundation of argument and then moving on to the structural or critical element from the perspective of established research mentioned above. They discuss the lecture, managing time, purposeful study, reading and taking notes from textbooks, vocabulary and concept development, memory, taking tests, writing as active learning, electronic tools, cooperative learning, and wrap their book with a discussion of issues.

Figure A.6.23: Bloom's Taxonomy of Learning



(Bloom, 1956, n.p.)

Anderson and Krathwohl (2001) present a revised Bloom's Taxonomy, both knowledge and cognitive process dimensions. Their book is very thorough and a good resource for faculty who desire to use Bloom's Taxonomy more deeply and meaningfully.

Figure A.6.24: Bloom's Revised Taxonomy of Learning

Bloom's Revised Taxonomy of Learning
Anderson & Krathwohl, (2001)

The Knowledge Dimension	The Cognitive Process Dimension					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Meta-Cognitive Knowledge						

(Anderson & Krathwohl, 2001, p. 100)

Multiple Intelligences
When discussing knowledge, it is important to take note of several other perspectives on knowledge and learning. Gardner's (1983/1993) work has been very important in that he identified six different ways to learn, which had implications for styles of learning. In *Frames of Mind, The Theory of Multiple Intelligences*, a seminal work, he discusses the importance of considering intelligence as "expressed in the context of specific tasks, domains, and disciplines" (p. xvi). The most significant advancement in multiple intelligence theory is that of distinguishing between intelligences, domains, and fields. The original work did not make these distinctions. There is now a taxonomy (Csikszentmihalyi & Csikszentmihalyi, 1988; Feldman, 1980, 1986; Gardner).

- <u>Intelligence</u> (and cognition) - intellectual strengths or competences…certain forms of cognition…a neural organization that proves hospitable to the notion of different modes of information processing (p. 59)
- <u>Intelligences</u> (at the individual level) - this is where one or more human intelligences exist or "human intellectual proclivities," neurobiological capabilities (p. xvi). The intelligences identified by Gardner are linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, and personal. He also suggests that there will never be an "irrefutable and universally accepted list. (p. 60)

Table A.6.7: Types of Human Intelligences

TABLE 5.1 Types of Human Intelligences

Intelligence	*Learner's Strengths*
Intrapersonal	Ability to know self; ability to understand one's own strengths/weaknesses and motivations
Interpersonal	Ability to know others; ability to "read" social and/or political situations; ability to influence others; ability to lead and/or care for others—to be sensitive to needs of others
Bodily-kinesthetic	Ability to control the movement of one's body; ability to move in graceful, highly coordinated fashion
Musical	Ability to produce, write, and/or appreciate music
Spatial	Ability to shape, perceive, design, and/or conceive visual-spatial information; ability to remember visual information
Logical-mathematical	Ability to manipulate numbers and symbolic information; ability to draw logical conclusions; ability to think abstractly
Verbal-linguistic	Ability to manipulate, create, and appreciate the rhythms of language; ability to speak, read, and/or write fluently

(Gardner, 1993, p. 62)

- Domain (or discipline) - part of the culture within which one is born, where disciplines, crafts, and other pursuits can be identified and where one becomes acculturated at varying levels of competency. Levels of competency can be assessed. These might be perceived as types or areas of expertise.

A relationship exists between intelligences and domains (e.g., a person exhibiting musical intelligence will probably be attracted to the domain of music), but other intelligences are necessary to achieve musical performances (e.g., bodily-kinesthetic, personal, etc.). Most domains require multiple intelligence proficiencies, while any one intelligence can be used across a wide variety of available domains.

- Field - a sociological construct – includes the people, institutions, award mechanisms, etc. that render judgments about the qualities of individual performances. To the extent that one is judged competent by the field, one is likely to become a successful practitioner; on the other hand, should the field prove incapable of judging work, or should it judge the work as being deficient, then one's opportunity for achievement will be radically curtailed.

When considering intelligences, one must first consider prerequisites for an intelligence and its inclusion in the list. Along with the criteria to determine an intelligence, there must be a counter set of criteria or factors that would suggest a competence or potential intelligence is not appropriate as an intelligence. Furthermore, Gardner (1983/1993) clearly states that when using the intelligences, it is important to remember that they are fiction, possibly useful fictions, for discussing processes and abilities, "separately defined and described strictly in order to illuminate scientific issues and to tackle pressing practical problems" (p. 70). He further describes each intelligence in depth. Additionally, he discusses educational processes and the application of the intelligences as ways of learning (e.g., observational learning situated in a particular context, instruction outside of the context in which the knowledge or skill is practiced) occur. Also there are three primary means or media of transmitting learning: direct forms with verbal interaction using articulated symbol systems (e.g., language or mathematics, books, charts, maps, computers, etc. or combinations of these media). Each media may differ in the kind of intelligence necessary. Second, there are sites or particular loci where learning can take place. This is where learners are placed for learning on site in a community of practice in the "real world" or in an institution of learning. The third variable is the agent, or person in charge of learning (e.g., teachers, professors, trainers, peers, etc.). It is his/her job to teach someone. Finally, Gardner discusses the "general context in which learning takes place" (p. 336): the cultural context where there may be great value differences towards intelligences depending upon the cultural context. A technological society or culture has different values than a religious cultural context. There is a wide range of educational settings and experiences (p. 339). (See the framework below to better understand educational and cultural settings.)

Table A.6.8: Framework for Analyzing Educational Processes

The Framework for Analyzing Educational Processes Applied to Three Cultural Settings

	Type of Learning		
Component of Education	*Specialized Skill in Nonliterate Society*	*Literacy in Traditional Religious School*	*Scientific Curriculum in Modern Secular School*
Examples Mentioned in Chapter 13	Puluwat sailing Yugoslavian oral verse	Koranic school Hindu gurukula Hebrew cheder Medieval cathedral school	Elementary and secondary schools in Europe, North America, and Japan; Programming on microcomputer
Intelligences	Linguistic, musical (oral verse) Spatial (sailing) Bodily-kinesthetic Interpersonal	Linguistic Interpersonal Logical-mathematical (among advanced students)	Logical-mathematical Intrapersonal Linguistic (less emphasized)
Media of Transmission	Mostly unmediated (direct observation) Some oral linguistic instruction	Oral verse or books	Great variety, including books, charts, computers, films, etc.
Locus of Learning	On site	Separate building or inside religious building	Separate building Some learning can be done in a private home or study
Agents Who Transmit Knowledge	Skilled elders, typically relatives	Individuals trained in literacy and argument; high moral comportment expected, status high except at entry level positions	Individuals with training in education at lower level; individuals with specialized training at higher levels; moral caliber not germane
General Context of Learning	Most individuals share some basic skills, including sailing; a few may be experts	Most males start out in religious school, gradual winnowing process; successful students often enter clergy or community elect	Universal primary and secondary education; many individuals have specialized postsecondary education, possibility of life-long individual-initiated education

(Gardner, 1983/1993, p. 339)

In *Teaching for Understanding*, Wiske (1998) reports on a study from 1988-1985 by Harvard Graduate School of Education with local schools, and although the research was K-12, it informs us as well. The foci of the project, and thus the book, was to define what is worth understanding for course topic organization – generative topics; to clarify what students would understand by the formulation of understanding goals; and to engage learners in performances of understanding, requiring them to extend, synthesize, and apply what they know. The Harvard project required "rich" performances that required students to learn and express themselves through the multiple intelligences and forms of expression, thus developing and demonstrating understanding. Finally, they measured students' understanding by conducting ongoing assessment of their performances – powerful through frequency, resulting in the generation of information to improve student performance and planning. The study was organized around teacher inquiry to help teachers analyze, design, enact, and assess practice with a focus on student understanding.

In consideration of "generative topics" for those who may not understand its meaning, it is the choice of curriculum topics that provide the opportunity to engage in inquiry that is open ended, where students can be generative rather than didactic, and where there is a very connected, correct, and direct result or answer. Generative learning engages students and teachers, interests and excites them, and motivates and stimulates them to develop understanding; these topics are controversial and connectable to other topics or disciplines.

When considering performances of understanding, it means exactly that students will demonstrate or perform using what they understand (e.g., authentic tasks requiring them to use what they understand). <u>Performances</u> should be both generative and challenging. Their three categories include <u>Messing about</u>, where the inquiry is informal and not bound or defined by discipline-based methods and concepts. This serves to draw students in to hook them or their interest, and students can engage regardless of their prior level of understanding, which helps them connect the topic to their own interests and previous experiences and to set the direction of their learning. <u>Guided inquiry</u> engages students in using formal ideas or modes of inquiry, those central to the goals or course, sometimes involving them in the development of skills in observation, recording of data, learning new vocabulary, and synthesizing information related to a particular question. Teacher guidance assists students in learning how to apply the particular disciplinary concepts or methods so their performances can grow more sophisticated and complex as do their understandings. <u>Culminating performances</u> (e.g., projects, exhibitions) engage students in the demonstration of particularly well defined mastery of the designated goals or outcomes. These are at the higher level of Bloom's Taxonomy. Preparing to teach for understanding requires that one understand "understanding." The tables below clearly illuminate the authors' meaning and go far to provide thoughtful reflection for our endeavor.

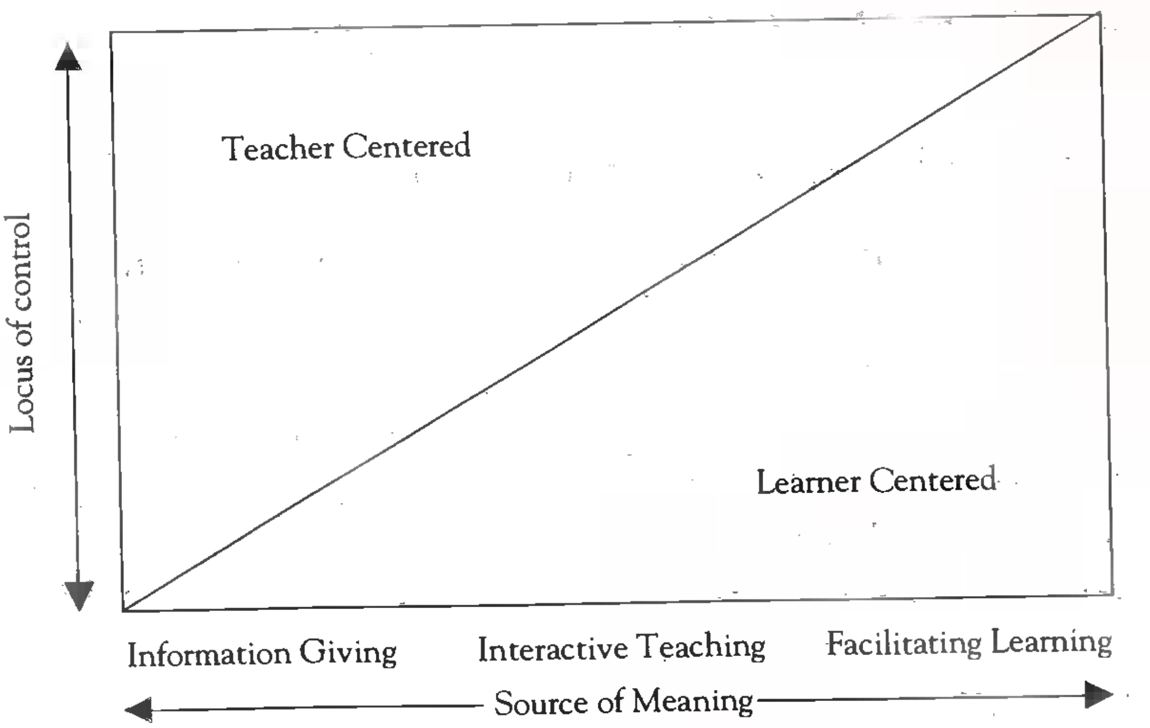
Table A.6.9: Four Dimensions of Understanding and Their Features

Knowledge	Methods	Purposes	Forms
A. *Transformed intuitive beliefs* To what degree do students' performances show that warranted theories and concepts in the domain have transformed students intuitive beliefs?	A. *Healthy skepticism* To what degree do students display a healthy skepticism toward their own beliefs and toward knowledge from such sources as their textbooks, people's opinions, and messages in the media?	A. *Awareness of the purposes of knowledge* To what degree do students see essential questions, purposes, and interests that drive inquiry in the domain?	A. *Mastery of performance genres* To what degree do students display mastery of the genres of performances they engage in, such as writing reports, giving presentations, or preparing the stage for a play?
B. *Coherent and rich conceptual webs* To what degree are students able to reason within richly organized conceptual webs, moving flexibly between details and overviews, examples and generalizations?	B. *Building knowledge in the domain* To what degree do students use strategies, methods, techniques, and procedures similar to those used by professionals in the domain to build reliable knowledge?	B. *Uses of knowledge* To what degree do students recognize a variety of possible uses of what they learn? To what degree do students consider the consequences of using their knowledge?	B. *Effective use of symbol systems* To what degree do students explore different symbol systems to represent their knowledge in effective and creative ways—for example, by using analogies and metaphors, colors and shapes, or movements?
	C. *Validating knowledge in the domain* Are truth, goodness, and beauty dependent on authoritative assertions, or rather on publicly agreed-upon criteria such as using systematic methods, providing rational arguments, weaving coherent explanations, and negotiating meanings through careful dialogue?	C. *Ownership and autonomy* To what degree do students evidence ownership and the autonomy to use what they know? To what degree have students developed a personal position around what they learn?	C. *Consideration of audience and context* To what degree do students' performances show an awareness of the audience, such as the audience's interests, needs, ages, expertise, or cultural backgrounds? To what degree do they show awareness of the context of the communication?

(Wiske, 1998, p. 184) See Wiske for further breakout.

What we hope to accomplish with our professors is multi-faceted but over generalized. We hope to move from teacher centered to learner centered courses, where professors are facilitators of learning and there is a balance of focus between learner, knowledge, assessment, and teacher (professor) (Farquharson, 1995).

Figure A.6.25: The Teaching-to-Facilitating Continuum



(Farquharson, 1996, p. 66)

In an environment where students are the center of learning and professor facilitators, professors, as teachers, need to demonstrate:

- Expertise: The Power of Knowledge and Preparation
  Connecting material to learner's life experience
  Adjusting content to allow for spontaneity and creativity
  Preparing teaching materials that build on motivation
- Empathy: The Power of Understanding and Consideration
  Checking out learner needs and expectations
  Shaping teaching to the learner's capacities
  Constantly considering the learner's perspective
- Enthusiasm: The Power of commitment and Animation
  Having a personal investment in what is taught
  Expressing emotion, animation, and energy
- Clarity: The Power of Language and Organization
  Ensuring that learners understand the logical connection of ideas
  Continuously checking learner comprehension (Farquharson, 1995, p.74 as cited in Wlodkowski, 1991, pp. 16-43)

Critical reflection involves assumption hunting, as our assumptions are our beliefs that give meaning and purpose to who we are and what we do (Brookfield, 1995). It is important to become aware of our implicit assumptions and how they frame how we think and act – a challenging intellectual puzzle. We instinctively resist challenging our

assumptions for fear of not liking what we might discover – clarifying and questioning what we have lived by for a long time. Brookfield identifies three categories of assumptions:

- Paradigmatic - the most difficult to uncover, the basic structuring axioms used by each of us to order the world into what we perceive as its fundamental categories. We may perceive these as objective, valid, and reality, facts we feel true. Often it takes great evidence to the contrary or a major disconfirming experience to achieve a shift of these assumptions. But when they are changed, there is usually an explosive consequence. Senge (1990) may call this type of shift in mind, metanoia. Learning that causes us to recreate ourselves.
- Prescriptive - what we believe ought to happen in particular situations; these are grounded in or extensions the paradigmatic assumptions.
- Causal - explains how different parts of the world work, the conditions required for changing its processes. Causal assumptions are usually stated in predictive terms, almost as "if" statements. If this is true, then this will happen. For example, "If we make mistakes in front of students, this creates a trustful environment for learning in which students feel free to make errors with no fear of censure or embarrassment." Causal assumptions are the most easily uncovered.

"Discovering and investigating our causal assumptions [are] the beginning of the reflective process; the process is not complete without examining our prescriptive and ultimately the deeper paradigmatic assumptions, those invisible rules that bind" (Brookfield, 1995, p. 3). When it comes to teaching, we operate according to our assumptions or beliefs. Without reflection, we risk making poor judgments and choices. Consider the following examples with corresponding comments after each one:

- Of course we know what is going on in our classrooms, after all, we've been doing this for a number of years, haven't we? This unexamined common sense assumption is a notoriously unreliable guide to action. (p. 4)

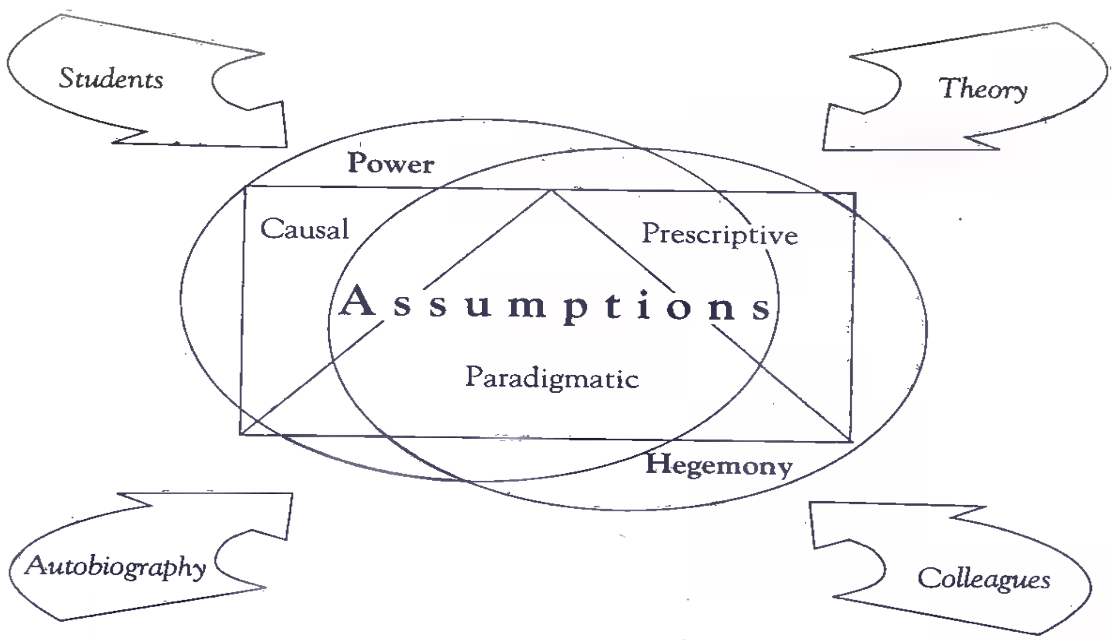
Critically reflective teachers recognize that good teaching is not always evaluated as good by students. The diversity of students in today's classrooms makes it impossible have uniform results. Also good performance evaluations of perfect scores may not serve students' interests; it could imply that we are not challenging students. Someone who scores a perfect "10" may be presumed (or is as likely) to be doing something wrong as right. The dynamics and contradictions of teaching cannot be reduced to quantification. And if we want to change our teaching, we must realize that the answers are not always "out there" available in some workshop, book, or article. Instead we must research our own teaching and practices, imported ones rarely fit faultlessly. There are not any simple answers; therefore, it is important to note that

> significant learning and critical thinking inevitably induce an ambivalent mix of feelings and emotions, in which anger and confusion are as prominent as pleasure and clarity…[The rule] that the customer is always right – is often pedagogically wrong….Equating good teaching with a widespread feeling among students that you have done what they wanted ignores the dynamics of teaching and prevents significant learning. (Brookfield, 1995, p. 21)

So, why is critical reflection so important:

> it helps us to take informed actions; to develop a rationale for practice; to avoid self-laceration; it grounds us emotionally, enlivens our classrooms, increases democratic trust; and, although ideological, critical reflection is morally grounded as it is the basis for the creation of conditions within which people can learn…anchored in values of justice, fairness, and compassion, critical reflection finds it political representation in the democratic process…In pedagogic terms, this means the creation of democratic classrooms…In terms of professional development, it means an engagement in critical conversation. (pp. 26-27)

Figure A.6.26: The Critical Reflection Process



(Brookfield, 1995, p. 30)

To assist in critical reflection, the following questions can be helpful. See The Classroom Critical Incident Questionnaire below.

Figure A.6.27: The Classroom Critical Incident Questionnaire

The Classroom Critical Incident Questionnaire

Please take about five minutes to respond to each of the questions below about this week's class(es). Don't put your name on the form—your responses are anonymous. When you have finished writing, put one copy of the form on the table by the door and keep the other copy for yourself. At the start of next week's class, I will be sharing the responses with the group. Thanks for taking the time to do this. What you write will help me make the class more responsive to your concerns.

1. At what moment in the class this week did you feel most engaged with what was happening?
2. At what moment in the class this week did you feel most distanced from what was happening?
3. What action that anyone (teacher or student) took in class this week did you find most affirming and helpful?
4. What action that anyone (teacher or student) took in class this week did you find most puzzling or confusing?
5. What about the class this week surprised you the most? (This could be something about your own reactions to what went on, or something that someone did, or anything else that occurs to you.)

(Brookfield, 1995, p. 115)

Brookfield's (1995) model for critical reflection uses four critically reflective lenses through which to view teaching:

- <u>Autobiographies as Learners and Teachers</u> - This puts us in the role of 'other.' We see our practice from the other side of the mirror, and we become viscerally connected to what our own students are experiencing – the first step on the critical path. Through personal self-reflection, we become aware of the paradigmatic assumptions and instinctive reasoning within which we work. Once we realize what these are, it is possible to test them for their accuracy and validity through conversations with others.
- <u>Students' Eyes</u> - Experiencing ourselves as our students see us makes us more aware of our actions and the underlying assumptions; this can serve to confirm or challenge the existing power relationships in the classroom and whether students are experiencing the "meanings" that we intend from our practice.
- <u>Colleagues' Experiences</u> - Peer observation can go far to see one's self through the eyes of colleagues, especially if we engage in critical conversations, as then we can consider aspects of our practice that are revealed through that observation and the conversations; often this process will reveal things that we ourselves cannot see in or about ourselves. When examining what they observed, we can view our practice through yet another lens.

- Theoretical Literature - Exploring the theoretical literature helps us to interpret what we are doing in multiple ways, e.g. naming what we are doing in different ways; illuminating generic aspects of what we though idiosyncratic events and processes. It can confirm what we are and should be doing, or it can contradict us and reveal other methods and processes to consider. (pp. 29-39)

When engaging in the processes described above, considering our practice from the lenses of others and the literature can be emotional, sometimes even painful. Critical reflection, like that of our students when learning new knowledge, involves the negotiation of our feelings because we are examining our practice critically. "Our practice becomes the object of systematic inquiry" (p. 39). Throughout the inquiry, we realize that there may be issues of power and control in our classrooms that prevent us from engaging students in ways that are more meaningful. To "empower" students requires actually "giving up" our own power. In my opinion, power is finite; if we authorize, or empower, students to take responsibility for their own learning and growth while we provide structured opportunities and facilitate the learning processes, then we must truly empower them in a way where they can make decisions on their own or in cooperative groups. We must honor those decisions, give up our power (and its corresponding authority) of making decisions for them. This means that we permit them to make mistakes; but remember, great learning can come out of academic mistakes. The problem or project is not the end in itself; it is the process through which to learn. So as we learn to view ourselves and our practice through a variety of lenses, our own lens will become more honest and revealing, more objective, and we will be more able to see our practice for what it is and, more importantly, what it can become. In terms from Brookfield (1995), we become more able to admit to the more oppressive aspects of our actions (in teaching practice) and move toward the creation of a more democratic classroom in which students have real power. We are more able to confront the issues and dilemmas, the contradictions that engage us daily and become better at realizing rationale to justify our methods and practice. We move from self ignorance, in my own terminology, to realizing that teaching is ideological in nature, that curricula is determined by individuals and should be perceived as constructed and tentative, and that it can be dismantled and reframed (and should be in my opinion) quite often.

It horrifies me that I know professors who rarely if ever change their course curricula, unless technology or scientific advances force them to. And, even then, I know of some who teach what they "frame" as the basics and do not make those changes. Of course, this is the negative side of the coin, but if we are honest with ourselves, we all realize there is so much more we can do with the curricula content! For example, how often do professors actually engage in the validation of their courses and entire curricula? Most are driven by commercial textbooks that are rarely good or well developed. When that is the case, I am not sure why we need professors. Our students are entirely capable of reading the text and learning what it has to offer with some assignments. When considering curricula, they are chosen by individuals or groups with their own agendas and interests. What they entail as content comes out of those agendas and interests, or lack of, and thus the reliance on the textbooks.

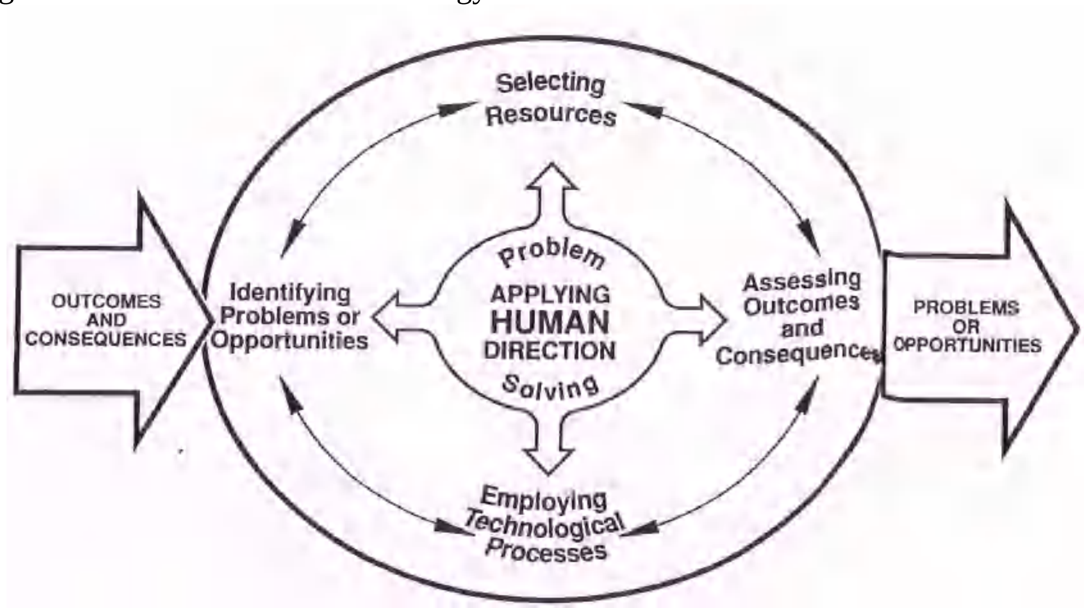
Teaching is ideological if someone truly appreciates the arts and practice of teaching. Because of power structures, moving towards democratic processes to determine curricula may threaten some who are in a "comfort zone" or "familiar routines" (p. 41). There is a risk in suggesting change in curricula or teaching processes. Colleagues may take their assumptions for granted, but if we are to survive and thrive, we must as unthreateningly as possible challenge others to question their own assumptions – as we are now doing. We must learn to minimize risk by being tactically astute and cunning when moving toward getting others to challenge common assumptions so they in turn will make changes in their teaching practice: challenge as non-threateningly as possible, as non-confrontationally as possible, yet in a way that moves the challenges forward to bear fruit and change where needed. This might be known as political astuteness.

At NIU, we have a great deal of academic and personal freedom with teaching methodology and our curricula. We do not have as a great a risk in challenging the status quo as in some other institutions. There is no risk in the changes that we are seeking through this initiative, and there is a great deal of administrative support. However, it is important to note the above statements as there are many individuals who assume their teaching practice is worthy, when in fact it is not, so we are dealing more with the challenge of motivating ineffective teaching professors to change to more effective practice than anything else.

When engaging in critical reflection as a teaching professional, our thinking becomes different; we begin to see value in professional development and feel a need to continue evolving. We begin to realize that we will never be "there" and that our ideas and practices will always need investigation. Our practice is an ongoing investigation. Therefore, we will enter into a new life cycle, one where we assess, take action, consider the results of that action, and then again engage in investigation. The following model is a good one, whether for ourselves or with our students.

Human problem solving involves beginning with prior outcomes or consequences of prior actions. These constitute the current problems or opportunities. When engaging in solving the problems or exploiting the opportunities, we use resources and technological processes, resulting, yet again, in another set of outcomes or consequences, which then present themselves as new problems or opportunities. Although this model is presented as a conceptual framework for technology education, to me it is a simple and somewhat generic model that works as a conceptual framework for solving problems, regardless of where used (Savage & Sterry, 1990). This model also works in the context of "problem-based learning and problem solving" discussed above.

Figure A.6.28: A Model for Technology Education



(Savage & Sterry, 1990)

Therefore, we, and our teaching, are in continual formation (evolving); our teaching becomes a connective activity, meaning that our approach has now become one of inquiry, always needing investigation and constantly forming or evolving. We learn, modify, and continue to change our practice, sometimes with contrary rhythms to those before – meaning one rhythm might develop as we study our own teaching and another may develop as we study how our students experience our practice. We make changes that enhance our connectivity to students as learners. We connect educational processes and students' experiences of learning and what students feel becomes a guiding principle. Hopefully, we arrive at a vision of democratic education, where the power has shifted and is shared. We achieve critical responsiveness that is driven by clearly articulated values and that is creative to the needs and concerns of students. We engage in fluctuating rhythms as we respond, making sure that what we do is grounded in an accurate understanding of what students are experiencing or not experiencing. To ensure that we are accurate, we engage with students in their critical reflections about what they are experiencing, how they connect or how they do not, why they disengage, and explore why sometimes our actions puzzle them or affirm them. This involves us in continuous exploration of connections, why they happen or do not, and goes far to explain the effects of our practice. In doing this, we begin to realize our own voices and those of our students. Democratic classrooms provide the opportunity for those voices to emerge. We begin to speak about our practice, authenticating it. As we speak about it, we learn about it even more deeply and become capable of identifying irrelevant "other" voices that are external with external interests. We begin to listen and hear our own voices and those of our students, using this to guide our practice. We begin not to seek that external approval of authority but rather what works. Mezirow (1991) calls "those deeply embedded internal injunctions that define the boundaries of what we allow ourselves to think – premise distortions. They are self-censorship devices – nagging voices of denial that set out acceptable interpretations of classroom events and that remind us constantly of what

practices are off-limits" (as cited in Brookfield, 1995, p. 45). As we mature in our ability to reflect critically, we begin to recognize these "jarring and dissonant" voices as those with false messages that are refuted by our practice. They simply bind us into ineffective practice.

As important as recognizing those limiting voices is hearing those voices who speak in alternate ways, those other voices who help us to take our own inner voices seriously. For example, when someone speaks and you realize that they are saying what you have been struggling to articulate, ultimately affirming something you believe in but have not put into words. These voices are important because they help you to admit out loud something you have hesitated to admit. The discovery, honoring, and expression of authentic voice is transforming. When we speak authentically or hear an authentic voice, our experience and our practice coheres in a way that is consistent. Finding our voice, about our practice, is powerful and fundamentally connected with developing our sense of agency. Once we can talk about and name our experiences in teaching, we begin to understand what we believe, what we do not, and why. This empowers us, gives us a source of action generated from within rather than imposed from external sources. We act with intent, drawing from our own knowing. We are critical, and we create our world, no longer merely responding or reacting to it. Agency means the connection between reflection and action. Power comes from intentional action, and we act on what we know and believe. Hopefully, those of us engaged in this initiative are discovering or deepening our understanding of our voices about teaching practice, and through the processes of analysis, learning, development, and intentional changes and decision making, we are becoming more powerful in our practice and our students will become more powerful as we move into more democratic practices and sharing of power.

12. Student Performance Assessment*

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The Education Commission of the States (1995) has identified the attributes of good practice for higher education, but they apply equally to secondary education. The commission argues that good assessment can lead to the transformation of education when considering "…that when [educators] systematically engage in these good practices, student performance and satisfaction will improve" (p.5). These quality indicators show the integral aspect of assessment. They provide evidence of successful teaching and learning or evidence for setting improvement goals and are also helpful in guiding and structuring improvements (Huba & Freed, 2000):

Quality begins with an organization culture that values

1. High expectations
2. Respect for diverse talents and learning styles
3. Emphasis on the early years of study [e.g., general education]

A quality curriculum requires

4. Coherence in learning
5. Synthesizing experiences
6. Ongoing practice of learned skills
7. Integrating education and experience

Quality instruction builds in

8. Active learning
9. Assessment and prompt feedback
10. Collaboration
11. Adequate time on task
12. Out-of-class contact with faculty (possibly an exception for secondary school teachers)

Wiggins and McTighe (2000) provide a "backwards" design process where student learning standards are considered as the foundation for all curriculum and instruction decisions and are followed by choosing the assessment procedure that will provide the desired type of evidence of learning. Wiggins (1998) identifies three types of educational standards: "Content standards: What should students know and be able to do? Performance standards: How well must students do their work? And Task (work-design) standards: What is worthy and rigorous

* Conard White served as primary leader of this program component.

work? What tasks should students be able to do?" (p. 106). Wiggins and McTighe state (pp. 110-111) that assessments should be

1. Credible to all stakeholders, but especially to teachers, parents, and older students.
2. Useful, meaning user-friendly and helpful to the student performers and their coaches, namely teachers.
3. Balanced, in the use of all assessment methods, to provide a rich, defensible and feasible profile of achievement, but anchored in authentic and complex performance tasks.
4. Honest yet fair, reporting how each student is doing against important standards but not uselessly ranking novices and experts against each other.
5. Intellectually rigorous and thought provoking; focusing on core ideas, questions, problems, texts, and knowledge; but also engaging and stimulating of inquiry and interest in intellectual work.
6. Feasible in terms of resources, logistics, politics, and redeployment of time for collaboratively designing, debugging, using, evaluating, and reporting work.

Lissitz and Schafer (2002, pp. 23-26) also provide standards for assessment quality:

1. Quality assessments arise from and accurately reflect clearly specified and appropriate achievement expectations for students.
2. Sound assessments are specifically designed to serve instructional purposes.
3. Quality assessments accurately reflect the intended target and serve the intended purpose.
4. Quality assessments provide a representative sample of student performance that is sufficient in its scope to permit confident conclusions about student achievement.
5. Sound assessments are designed, developed, and used in such a manner as to eliminate sources of bias or distortion that interfere with the accuracy of results.

Kuhs et al. (2001, p. 2) add that "in addition to guiding classroom instruction," assessment helps teachers

- formulate plans and strategies to support the instructional needs of students
- share information with students about their progress
- collect information to assign student grades
- evaluate the effectiveness of their instructional strategies and curricula
- prepare summative information on student progress for decisions such as promotion, retention, assignment to special programs, and referrals to other needed assistance programs.

Additionally, they (p. 4) offer characteristics of quality assessment through the following questions:

1. Does the assessment focus on knowledge and skills that were taught in class and are outlined in district curriculum guides and in state and national content standards?
2. Does the assessment provide information about student learning that represents typical performance?
3. Does the assessment provide opportunities for all types of students to demonstrate what they have learned?

These authors also discuss the types of assessments, observation, performance tasks, scoring-guides checklists and rubrics, tests, portfolios, and interviews, as well as what they term a multifaceted assessment system (Figure 1).

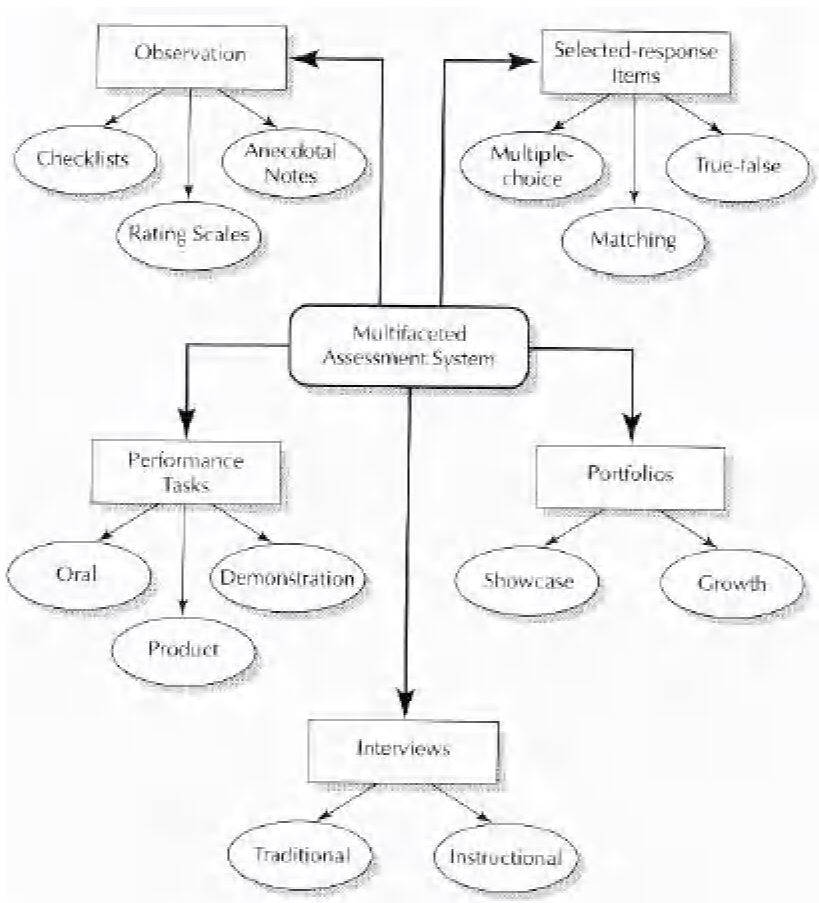

Figure 12.1 Multifaceted Assessment System (Kuhs et al., 2001, p. 157)

Teachers rely greatly upon "teacher-made tests." Most of the teachers we worked with identified test construction as an area in which they felt little confidence about their own capabilities. The second area within testing is grading. The meaning of grades within a single course by one teacher, and across several courses by several teachers, as judgments about student learning or achievement can be problematic when considering all the factors and issues. And finally, teachers are aware of a current focus on student performance assessment versus traditional testing, but not of how the two relate; therefore, how to develop performance tests and rubrics

has also been an important area for professional development. Teachers are somewhat confused by the movement toward performance assessment, while the continued reliance of schools on standardized testing makes them question the value of active learning and performance-based assessment. Most teachers understand the test as the terminal measurement of student achievement rather than understanding that tests or "test items are meant to be useful as *indicators* of valued 'real world' performances" (Linn & Baker, 1996, as quoted in National Society for the Study of Education, 1996, p. 85). Therefore, performance assessments should create additional opportunity for students to provide evidence they can use the knowledge measured on the test.

Wiggins (1998) defines "educative assessment" as "deliberately designed to teach (not just measure) by revealing to students what worthy adult work looks like (offering them authentic tasks). It should provide rich and useful feedback to all students and to their teachers, and it should be designed to assess the use of feedback by both students and teachers" (p. 12). A learning-centered assessment system should

1. Be designed to improve performance (of student and teacher)…built upon a bedrock of meaningful performance tasks that are credible and realistic (authentic), hence engaging students. This system must also:
   a. Be open – that is based on tasks, criteria, and standards known to students and their teachers…less reliant on audit testing methods that require test questions are kept a secret.
   b. Model exemplary instruction, encouraging rather than undercutting desirable teaching practice and showing all teachers how the most rich and vital educational goals and pedagogies can be assessed.
   c. Use grades that stand for something clear, stable, and valid…linked directly to credible and important state or national standards for assessing performance on authentic tasks.
   d. Measurably improve student performance over time so that standards once thought very high and reachable by only a few become reasonable expectations for many students.
2. Provide useful feedback to students, teachers, administrators, and policymakers. A useful feedback system must:
   a. Provide data and commentary that are rich, clear, and direct enough to students and teachers to self-assess accurately and self-correct their own performances increasingly over time….not center on praise and blame.
   b. Provide ample opportunities to get and use timely and ongoing feedback. (Wiggins, 1998, pp. 12-13)

Wiggins (pp. 17-18) presents five key ideas on assessment and its reform:

1. Assessment must center on purpose, rather than merely on techniques or tools.
2. Assessment is a moral matter in that teachers and students are entitled to systems that are user friendly and enhance teaching.

3. Assessment is central to instruction, not peripheral to it.
4. Assessment "anchors teaching, and authentic tasks anchor assessment."
5. Performance improvement is local. Although guided by national and state standards, student learning occurs locally.

A Balanced Assessment System

The best approach is to use a variety of assessment tools or procedures to produce a balanced system over the course of the standards to be achieved. The idea is to offset the limitations of one type of assessment against the strengths of another.

A balanced system should include good and reliable traditional assessment, performance assessment, and portfolio assessment. Traditional assessment is typically used to determine grades and rankings, whereas performance assessment provides the opportunity to observe learning results, and portfolio assessment provides the opportunity to determine growth and development over time. A system encompassing various assessments can develop students' ability to perform in types of assessment where they have traditionally shown weaker performance, while also giving them the opportunity to perform through procedures in which they have excelled (Wiggins, 1998, pp. 115-116). (See Figures 2 and 3.)

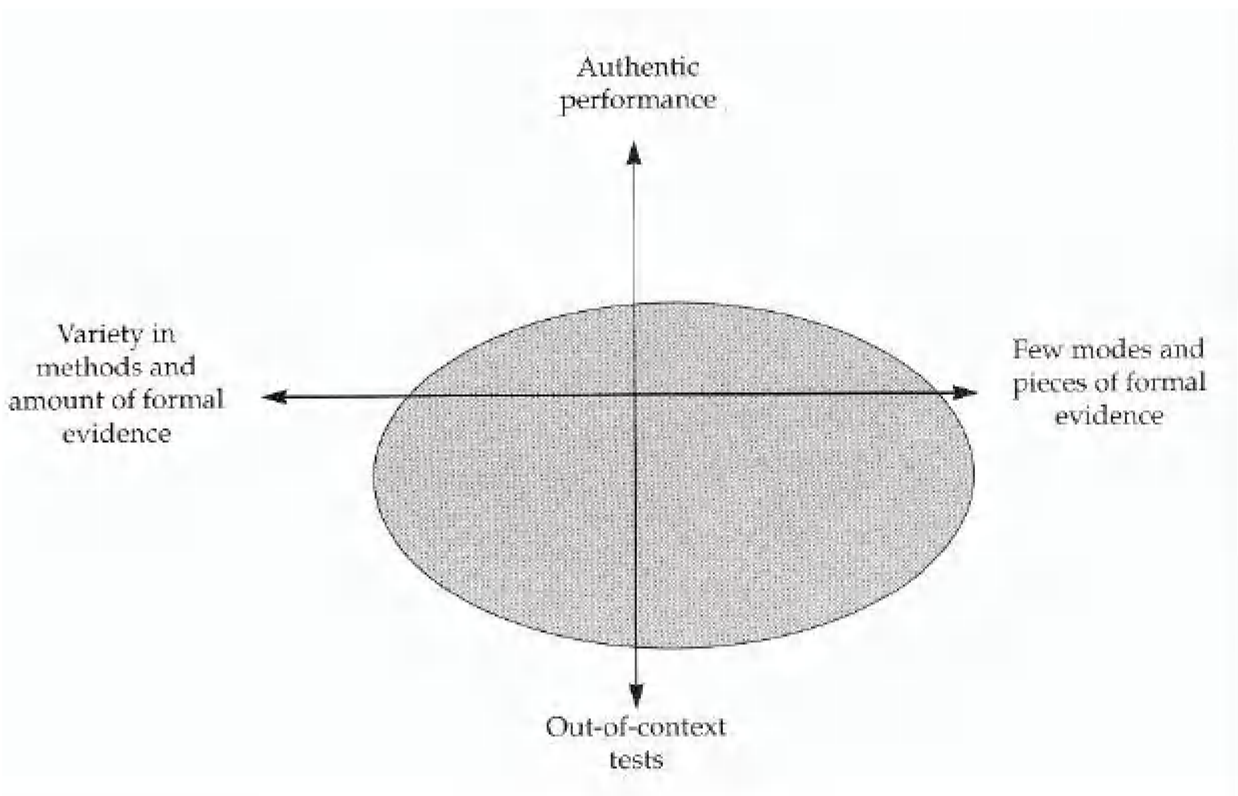

Figure 12.2 Typical Unbalanced Assessment in Classrooms and Schools (Wiggins, 1998, p. 115)

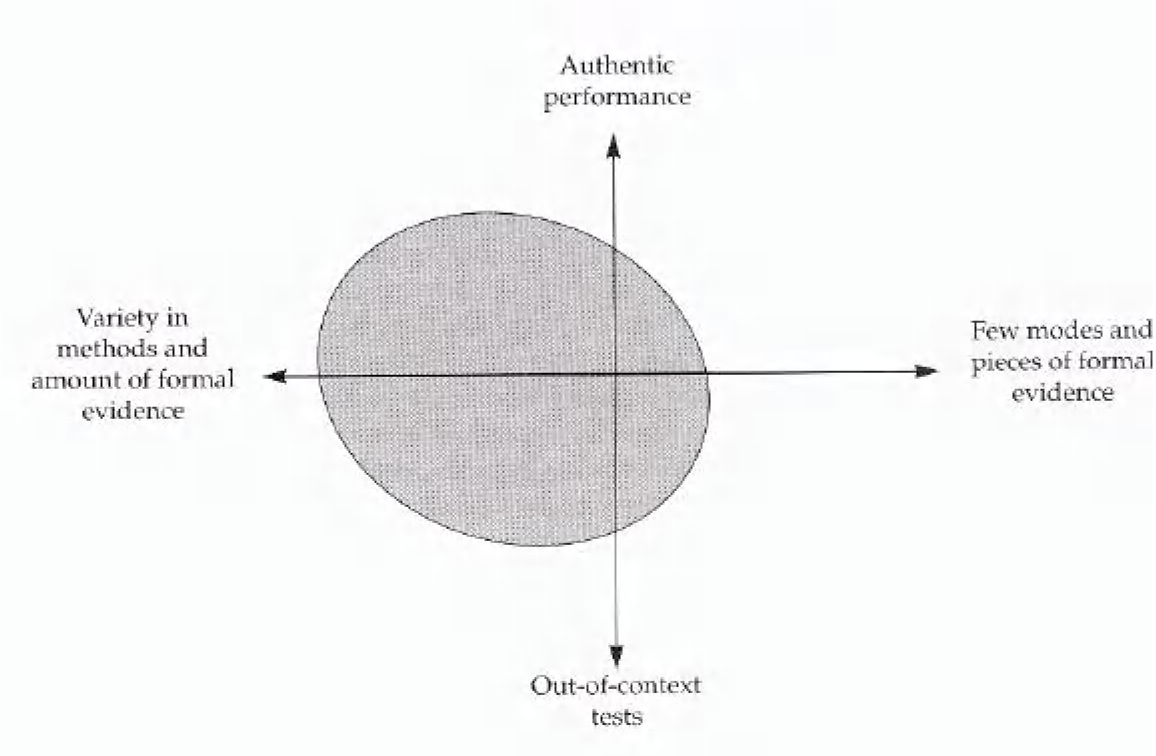

Figure 12.3 Exemplary Assessment Balance (Wiggins, 1998, p. 116)

When providing professional development for teachers, it is impossible to address all student assessment issues in a single program. Therefore, we chose to focus on improving their traditional test development skills by working with them on the development of their module pretests and posttests, making sure that those tests were measuring student progress toward achieving standards. However, to introduce them formally to more authentic performance assessment, we helped them understand what authentic means, what a performance is, and how to identify performances that provide evidence of student learning of vital concepts and principles. This is where providing experiences in real-world industry, business, or community organizations helped them transform "theory into action."

Many teachers struggle to distinguish among (1) knowledge, the concepts or principles of a discipline; (2) cognitive skills that transcend all disciplines and learning; and (3) other types of skills, ranging from academic skills (such as reading), the problem-solving process, the organization of information, and beyond that, discipline-specific skills. Of course, there is a fine line between labeling some of these "knowledge" versus "skills." In addition and very importantly, many teachers are not secure in knowing the difference between the knowledge taxonomy of their discipline and the more contextual "curriculum content" within which knowledge or skills can be embedded or taught. For example, teachers may identify computer-aided-design (CAD) software functions as knowledge, whereas mechanical drawing or engineering graphics concepts such as cross-sectional views would be a concept, and the software functions and hardware components of CAD would be technological tools. Another example is from English: a knowledge concept would be figurative or persuasive writing, whereas the novel would be the contextual content within which the concepts and principles of

writing are applied. We have often found teachers testing on the novel rather than the knowledge, concepts, and principles involved in writing literature.

Education versus training is something else to consider. The intent of educators is to teach knowledge that can be used across learning (courses or disciplines) or real-world contexts. Use of a concept or principle requiring interpretation, reasoning, practical application, and comprehension at the Bloom's Taxonomy levels of synthesis and evaluation, or the "create" level of the revised Bloom's Taxonomy, takes place through education processes (Anderson & Krathwohl, 2001). Education is often combined with training. For example, education should occur on mechanical drawing knowledge, while training should occur on the CAD software and hardware. An example of training without education is when students use a "template" approach to algebraic formulae but are unable to find a mistake because they have no understanding of the relationships between the factors in the formula.

The standards movement has made it easier to bring teachers to an understanding about what they should be measuring. When teachers understand the critical questions to ask themselves – what standards they want students to achieve, what level of achievement is desired, what the best method of assessing the learning is, and ultimately how to contextualize what is to be learned – they can then move on to other instructional decision making. They begin to understand that performance assessment should be intertwined with learning. Traditional testing is artificial and requires a "time out" for testing memory or comprehension, such as making simple comparisons. Many teachers are striving to infuse more critical thinking into traditional test items; others are rewriting traditional test items to ensure concept attainment when allowing use of technology while taking the test. Authentic and performance-based assessment, however, differs in that often students will not feel that they are being tested but that they are performing while learning and learning while performing. The two are not artificially separated. It is more a culture of achieving outcomes through performance tasks. To us, a complex performance task is one that embeds several performances as a cluster; that cluster is embedded within a real-world scenario and the performance tasks are as authentic as possible. The performances require a range of outcomes, such as the use of knowledge at the upper critical thinking levels and the use of cognitive skills, and may include a requirement that students use academic and other skills within a context to which they can relate. The question of "what" is to be measured and then the alignment of the achievement targets with assessment methods is critical. Chatterji (2003, pp. 96-98) identifies five types of assessments:

1a. Written structured-response assessments – usually timed, fixed, or selected response, written exercises

1b. Written open-ended assessments – usually timed, constructed response, written exercises

2. Behavior-based assessments – behaviors or demonstrations exhibited in natural or structured settings
3. Product-based assessments – products, reports, or items created in structured or unstructured situations
4. Interview-based assessments – one-on-one verbal (oral) interaction in structured or unstructured situations

5. Portfolios – purposeful collections of behaviors or work samples made over time

Lissitz and Shafer (2002) provide an example of matching targets to methods (Table 1).

Table 12.1 Aligning Achievement Targets to Assessment Methods (Lissitz and Shafer, 2002)

Target to Be Assessed	*Assessment Method*			
	Selected Response	*Essay*	*Performance Assessment*	*Personal Communication*
Knowledge Mastery	Multiple choice, true/false, matching, and fill-in can sample mastery of elements of knowledge	Essay exercises can tap understanding of relationships among elements of knowledge	Not a good choice for this target—three other options preferred	Can ask questions, evaluate answers, and infer mastery—but a time-consuming option
Reasoning Proficiency	Can assess understanding of basic patterns of reasoning	Written descriptions of complex problem solutions can provide a window into reasoning proficiency	Can watch students solve some problems and infer about reasoning proficiency	Can ask student to "think aloud" or can ask follow-up questions to probe reasoning
Skills	Can assess mastery of the prerequisites of skillful performance—but cannot tap the skill itself	Can assess mastery of the prerequisites of skillful performance—but cannot tap the skill itself	Can observe and evaluate skills as they are being performed	Strong match when skill is oral communication proficiency; also can assess mastery of knowledge prerequisite to skillful performance
Ability to Create Products	Can assess mastery of of knowledge prerequisite to the ability to create quality products—but cannot assess the quality of products themselves	Can assess mastery of knowledge prerequisite to the ability to create quality products—but cannot assess the quality of products themselves	A strong match can assess: (a) proficiency in carrying out steps in product development and (b) attributes of the product itself	Can probe procedural knowledge and knowledge of attributes of quality products—but not product quality

Source: Student-Involved Classroom Assessment, 3/e, by R. J. Stiggins, © 2001. REPRINTED BY PERMISSION OF PEARSON EDUCATION, INC., UPPER SADDLE RIVER, NJ 07458.

Wiggins (1998, p. 23) presents the key differences between typical tests and authentic tasks (Table 2). Also important is the question, "To what level of achievement?" Along with the original Bloom's Taxonomy (Table 3) (Bloom, 1956), I use the revised Bloom's Taxonomy in *A Taxonomy for Learning, Teaching, and Assessing* (Anderson & Krathwohl, 2001, p. 100). This schema (Table 4) identifies the types of knowledge and reveals changes in the cognitive process dimension. When using this taxonomy to plan my own teaching and student learning, I may still need the "synthesis" level of the original Bloom's Taxonomy, but "create" as the final category is very appropriate and does inherently require synthesis. Another very useful aspect of *A Taxonomy for Learning, Teaching, and Assessing* is a table comparing the original Bloom's Taxonomy to other multidimensional classification systems.

Table 12.2 Key Differences between Typical Tests and Authentic Tasks (Wiggins, 1998, p. 23)

Typical Tests	*Authentic Tasks*	*Indicators of Authenticity*
Require correct responses only	Require quality product and/or performance, and *justification.*	We assess whether the student can explain, apply, self-adjust, or justify answers, not just the correctness of answers using facts and algorithms.
Must be unknown in advance to ensure validity	Are known as much as possible in advance; involve excelling at predictable demanding and core tasks; are not "gotcha!" experiences.	The tasks, criteria, and standards by which work will be judged are predictable or known—like the recital piece, the play, engine to be fixed, proposal to a client, etc.
Are disconnected from a realistic context and realistic constraints	Require real-world use of knowledge: the student must "do" history, science, etc. in realistic simulations or actual use.	The task is a challenge and a set of constraints that are authentic—likely to be encountered by the professional, citizen or consumer. (Know-how, not plugging in, is required.)
Contain isolated items requiring use or recognition of known answers or skills	Are integrated challenges in which knowledge and judgment must be innovatively used to fashion a quality product or performance.	The task is multifaceted and non-routine, even if there is a "right" answer. It thus requires problem clarification, trial and error, adjustments, adapting to the case or facts at hand, etc.
Are simplified so as to be easy to score reliably	Involve complex and non-arbitrary tasks, criteria, and standards.	The task involves the important aspects of performance and/or core challenges of the field of study, not the easily scored; does not sacrifice validity for reliability.
Are one shot	Are iterative: contain recurring essential tasks, genres, and standards.	The work is designed to reveal whether the student has achieved real versus pseudo mastery, or understanding versus mere familiarity, over time.
Depend on highly technical correlations	Provide direct evidence, involving tasks that have been validated against core adult roles and discipline-based challenges.	The task is valid and fair on its face. It thus evokes student interest and persistence, and seems apt and challenging to students and teachers.
Provide a score	Provide usable, diagnostic (sometimes concurrent) feedback: the student is able to confirm results and self-adjust as needed.	The assessment is designed not merely to audit performance but to improve future performance. The student is seen as the primary "customer" of information.

Table 12.3 Bloom's Ranking of Thinking Skills (Bloom, 1956, p. 100)

Bloom's Ranking of Thinking Skills					
Knowledge	**Comprehension**	**Application**	**Analysis**	**Synthesis**	**Evaluation**
List Name Identify Show Define Recognize Recall State Visualize	Summarize Explain Interpret Describe Compare Paraphrase Differentiate Demonstrate Classify	Solve Illustrate Calculate Use Interpret Relate Manipulate Apply Modify	Analyze Organize Deduce Contrast Compare Distinguish Discuss Plan Devise	Design Hypothesize Support Schematize Write Report Justify	Evaluate Choose Estimate Judge Defend Criticize

Table 12.4 Taxonomy Table (Anderson & Krathwohl, 2001, p. 100)

The Knowledge Dimension	The Cognitive Process Dimension					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual knowledge						
B. Conceptual knowledge						
C. Procedural knowledge						
D. Meta-cognitive knowledge						

MAJOR TYPES AND SUBTYPES	EXAMPLES
A. FACTUAL KNOWLEDGE—The basic elements students must know to be acquainted with a discipline or solve problems in it	
AA. Knowledge of terminology	Technical vocabulary, musical symbols
AB. Knowledge of specific details and elements	Major natural resources, reliable sources of information
B. CONCEPTUAL KNOWLEDGE—The interrelationships among the basic elements within a larger structure that enable them to function together	
BA. Knowledge of classifications and categories	Periods of geological time, forms of business ownership
BB. Knowledge of principles and generalizations	Pythagorean theorem, law of supply and demand
BC. Knowledge of theories, models, and structures	Theory of evolution, structure of Congress
C. PROCEDURAL KNOWLEDGE—How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods	
CA. Knowledge of subject-specific skills and algorithms	Skills used in painting with watercolors, whole-number division algorithm
CB. Knowledge of subject-specific techniques and methods	Interviewing techniques, scientific method
CC. Knowledge of criteria for determining when to use appropriate procedures	Criteria used to determine when to apply a procedure involving Newton's second law, criteria used to judge the feasibility of using a particular method to estimate business costs
D. METACOGNITIVE KNOWLEDGE—Knowledge of cognition in general as well as awareness and knowledge of one's own cognition	
DA. Strategic knowledge	Knowledge of outlining as a means of capturing the structure of a unit of subject matter in a text-book, knowledge of the use of heuristics
DB. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	Knowledge of the types of tests particular teachers administer, knowledge of the cognitive demands of different tasks
DC. Self-knowledge	Knowledge that critiquing essays is a personal strength, whereas writing essays is a personal weak-ness, awareness of one's own knowledge level

Figure 12.4 Major Types and Subtypes of the Knowledge Dimension (Anderson & Krathwohl, 2001)

The Kolb Learning Cycle is also a useful tool. Fry et al. (2003) define experiential learning as "learning by doing" (p. 14). They credit Kolb for the most popular theory of learning from experience. Experiential learning is based on the notion that understanding is not a fixed or unchangeable element of thought but is formed and re-formed through experience, "a continuous process often represented as cyclical, and, being based on experience, implies that we all bring to

learning situations our own ideas and beliefs at different levels of elaboration" (p. 14). The Kolb Learning Cycle requires four abilities when learning is successful (p. 15).

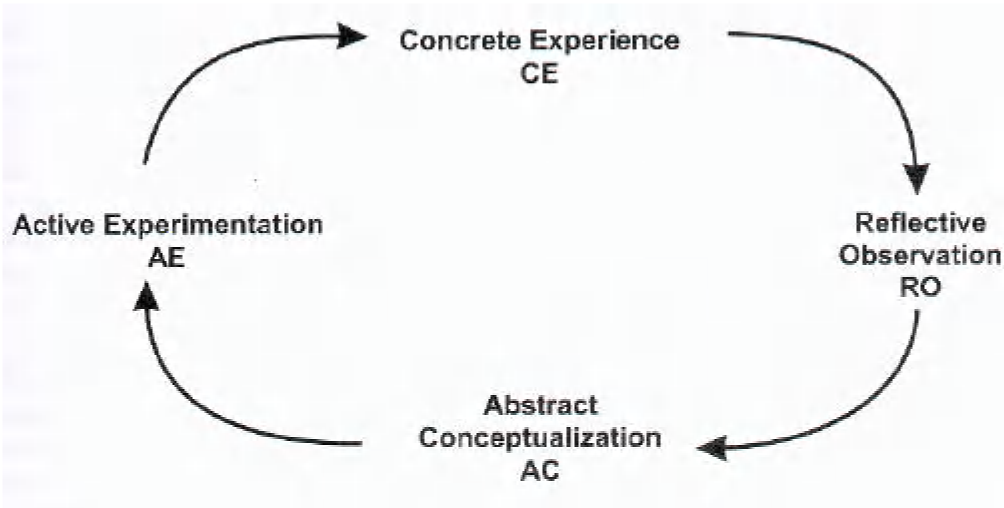

Figure 12.5 Kolb Learning Cycle (Fry et al., 2003, p. 15)

For our purposes, this cycle can be used as a metric, just as the Bloom's and revised Bloom's taxonomies can be, to guide the planning, execution, and evaluation of teaching and learning. This approach makes it possible to deepen learning and broaden understanding and application of knowledge across contexts and produces more authentic learning and deeper learning.

Assessment as Learning

So far, we have mentioned assessment *of* student learning, the dominant type in schools today. Now, let us discuss two other types, assessment *for* learning and assessment *as* learning (Table 5). Assessment *for* learning requires a fundamental shift from summative assessment (evaluative judgment) to formative (ongoing) assessment, where descriptions are created that can guide or inform the next stage of learning:

> [T]eachers collect a wide range of data so that they can modify the learning work for their students. They craft assessment tasks that open a window on what students know and can do already and use the insights that come from the process to design the next steps in instruction…Marking (scoring or grading) is not designed to make comparative judgments among the students but to highlight each student's strengths and weaknesses and provide them with feedback that will further their [individual] learning. (Earl et al., 2003, p. 24)

This changes the teacher's role. Teachers are central in the assessment of learning, but in assessment *for* learning, they use their knowledge of the student and the learning context to determine learning needs. The timing is also different as assessment *for* learning happens throughout learning, usually more than one time, not at the end as with assessment *of* learning. In assessment for learning, teachers interact with students differently and record-keeping is more

of the checklist, rubric, and portfolio type, showing a progression of student learning along a continuum (Table 5; Figures 6 and 7).

Assessment *as* learning has been our model, for we believe that teachers and students perform best *while* learning and that assessment activities can *serve as the learning mechanism.* When assessment is effective, the students (in our case the teachers and ultimately their students) become self-motivated and do not wait for the teacher (our program leaders) to "judge" whether their answer or work is correct. Rather, reflection and the construction of meaning enable them to realize, on their own or with team members, when they do not understand something. They then take steps to figure out what they need and where or how to find it. Comparisons *between* individual teachers or students are no longer relevant; rather they compare their own growth or progress with their prior knowledge, skills, or abilities.

When working with teachers, we generally made performing and learning indistinguishable from each other, one driving the other. The teachers presented, discussed, and ultimately owned the goals or standards they achieved. Then they participated in learning activities with the needed integral knowledge and skill development. As they learned, they developed new products, attitudes and behaviors, and processes, or performed using new strategies, models, techniques, or procedures. They were both learning and being assessed, simultaneously.

This is one method of "curriculum embedded assessment" where the traditional test at the end is replaced by the culminating product or performance. Ongoing immediate feedback is critical in this process, but it can be informal as well as formal. Performance-based assessment is usually not arbitrarily separated from learning and is less artificial than tests, which are merely *indicators* of potential performance ability or of "valued real-world performances" (Wolf & Reardon and Linn & Baker, as cited in National Society for the Study of Education, 1996, pp. 19-20, 85).

Table 12.5 Features of Assessment of, for, and as Learning

Approach	*Purpose*	*Reference Points*	*Key Assessor*
Assessment *of* Learning	Judgments about placement, promotion, credentials, etc.	Other students	Teacher
Assessment *for* Learning	Information for teachers' instructional decisions	External standards or expectations	Teacher
Assessment *as* Learning	Self-monitoring and self-correction or adjustment	Personal goals and external standards	Student

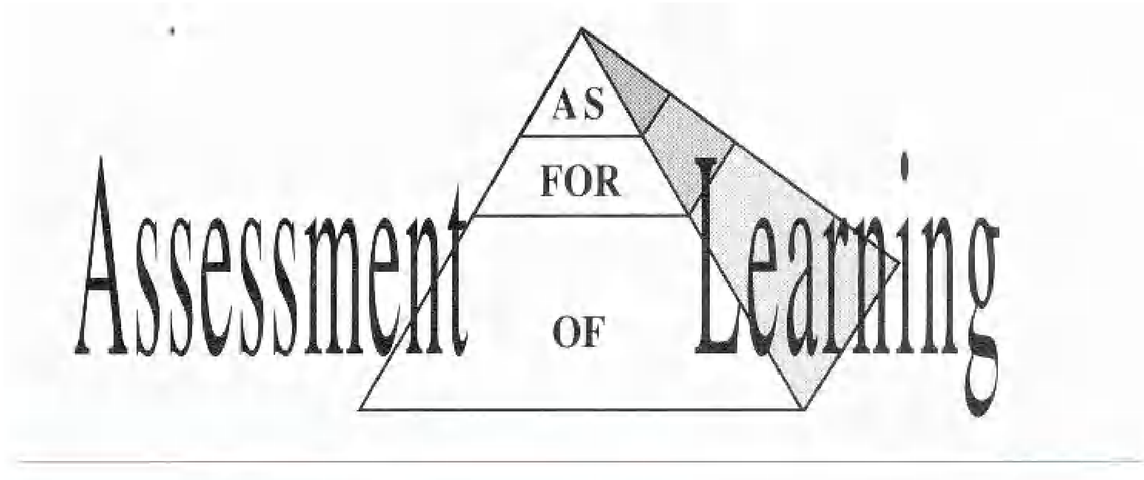

Figure 12.6 Traditional Assessment Pyramid (Marzano et al., 1993, pp. 26-27)

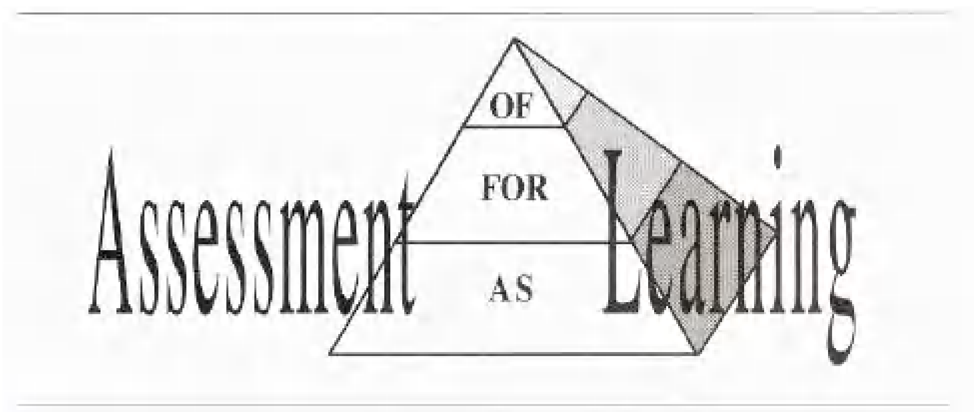

Figure 12.7 Reconfigured Assessment Pyramid (Marzano et al., 1993, pp. 26-27)

Authentic or Performance-Based Assessment

Standardized tests force instruction to focus on the

> accumulation of facts and decontextualized skills. A very different approach is offered by the National Council of Education Standards and Testing, the National Education Goals Panel, the New Standards project, the American Association for the Advancement of Science, the National Councils of Teachers of English and Mathematics, and others. They advocate for curriculum reforms that emphasize reasoning, higher-order thinking skills, and identification and solution of real-world (authentic) problems. Therefore, authentic performance-based assessments are critical and integral to those reforms and considered exemplary instructional practice where assessment and instruction are indistinguishable from each other. (Linn & Baker, as cited in National Society for the Study of Education, 1996, p. 85)

The National Education Goals Panel, in its first report, identifies a need for higher standards related to student assessment. Its authors advise that (authentic) performance-based

assessments may be more closely aligned with educational goals than standardized tests (p. 86). They (pp. 87-89) provide the following characteristics for performance-based assessment:

1. Be open-ended. Require the student to construct a response or perform an activity.
2. Involve higher-order, complex skills. These would include formulating and solving problems, reasoning, and communication.
3. Require extended periods of time for performance. Include the collection and analysis of data as well as the preparation of written or oral presentations of results and conclusions.
4. Involve group performance. Students working together may be asked to formulate hypotheses and design experiments.
5. Give student and teacher a choice of tasks. Performance-based assessments often allow some degree of latitude in the choice of tasks.
6. Rely on judgmental scoring. This requires scoring guidelines or rubrics and training.

In addition, there is much to be considered if the desire is to design valid and reliable performance tasks. Content quality, curricular importance, cognitive complexity, linguistic appropriateness, ancillary skills, and the meaningfulness of the tasks for students are all important considerations in the development of performance tasks. Also important are the consequences for students and teachers, fairness when assessing diverse learning groups, the transferability of results, how to compare results over time with confounding cohort differences, and instructional sensitivity to the general intellectual ability of the students. And finally, technical quality is a definite requirement for performance assessments (Linn & Baker, as cited in National Society for the Study of Education, 1996; McMillan et al., 2001).

Wiggins (1998, pp. 139-140) establishes that performance tasks should be:

- *Authentic*: they should have realistic options, constraints, criteria, standards, and audience, and a genuine purpose.
- *Credible:* they should address rigorous content and performance standards.
- *User-friendly:* they should be feasible, appropriate, engaging, and rich in feedback, with rehearsal and revision built in. They should provide a clear and complete set of instructions, guidelines, and models; and troubleshooting should be available.

Wiggins is careful to warn readers that while performance-based and authentic do not mean the same thing, they are often used interchangeably (pp. 140-141):

1. Just because it is a performance task does not mean that it is authentic. Not all performance tasks reflect the real world.
2. A task involving hands-on work is not necessarily authentic. It may not involve the methods and procedures of the real world, or perhaps the answers are already known.
3. A constructed-response task may not be authentic or even a performance task. Performance or production requires the student to plan and execute a new work from scratch and to use good judgment in choosing content and shaping a product.

4. A task that is authentic is not necessarily valid. Validity entails the ability to infer about performance based on an apt sample of work. Many authentic challenges make poor assessment tools because they do not permit easy isolation of performance.
5. Just because a task is inauthentic does not make it invalid.

To support teachers in their development of high-quality assessments and performance tasks, we provided teachers with examples and gave immediate and continuous feedback as they designed and developed their performance tasks. Wiggins (1998) has easy-to-use guidelines; we also used Hart (1994).

Scoring and Grading

Rubrics make public the key criteria that students use in developing, judging, and revising their work. Rubrics hold both the student and teacher accountable. Students know and understand what they have to do to achieve at established levels, and teachers cannot "change the rules" once the rubrics are in the hands of the students. Rubrics also build consistency in scoring or grading, while reducing bias. And most importantly, students are rarely surprised by their scores or grades (Huba & Freed, 2000).

Teachers enthusiastically reported that using rubrics resulted in higher-quality student work, more learning, improved scoring or grading, and better teacher-student relationships. They also felt that the self-assessment integral to the use of rubrics motivated students to achieve at higher levels.

There are all kinds of rubrics. We developed very simple ones for use in scoring the teachers' performance tasks, rubrics, and, ultimately, curricula modules. In considering what good rubrics need, the following elements are important:

- Levels of mastery describe the level the student has achieved.
- Dimensions of quality can be discipline specific or include general education knowledge and skills, cognitive processes, procedural knowledge, etc.
- Organizational groupings are clusters of criteria within a particular grouping.
- Commentaries are the descriptions of each criterion by level.
- Description of consequences is where the teacher reveals the consequences of performing at a given quality level in a real-life setting. A form of feedback encourages students to think about what will happen in a real-world setting. (Huba & Freed, 2000, p. 167)

Rubrics can broadly accomplish two important things: educate students and judge their work. Students learn the expected or optional standards of the discipline or profession, internalize them, and build aspirations for themselves, connecting what they are learning to their real world after graduation. Students also become informed about what constitutes poor, good, and excellent qualities of work or performance. They can use this to self-assess, provide themselves with feedback, and then correct their work before turning it in to the teacher. Teachers asked us for benchmarks or work that exemplified qualities of work that we expected of them. Huba and Freed (2000) have suggested that students examine "ungraded" work across

various levels of quality: “When students have an opportunity to examine assignments that differ in quality, they usually find that their own work is enhanced” (p. 170).

There are a variety of styles of rubrics, some with descriptions as in the samples provided below, and others with more simply stated criteria below each standard (Figures 8 through 14 in the appendix; also see examples on the website, www.strategicalliance.niu.edu.).

Rubrics must have prescribed standards and criteria levels for each standard, establishing various levels of achievement possible with a point system. Standards can be absolute or developmental. The absolutes are those exemplary benchmarks established de facto as the best. Developmental standards are established for particular cohorts (e.g., high school versus college), so excellence is determined for each type of cohort. Expectations are different in nature. Expectations reflect patterns or norms for groups; in other words, a student is expected to perform at a particular level because there is a pattern of that result for his or her ability and experience levels. “Students can exceed norms and expectations but still not perform up to standard” because norms have the effect of “hiding how students and teachers are doing when judged against worthy standards” (Wiggins, 1998, pp. 157-158). Good rubrics have a logic and chronology. They also, as with performance tasks, need to be valid in that the appropriateness and validity of the criteria and descriptors for discrimination, or making judgments against, are valid in relation to the tasks. These are holistic and analytic trait rubrics. Criteria are often of five types: impact, craftsmanship, methods, content, and sophistication of performance. One need not use all five all the time; “the challenge is to make sure that we have a feasible set of right criteria and that we have distinguished between genuine criteria and mere indicators or useful behaviors” (p. 168). Weights are important considerations. For example, should processes and results be weighted the same or should the mechanics of writing and the content be equally weighted? Rubric descriptors should address both strengths and errors in the work or performance judged.

Summing up Rubrics

According to Wiggins (1998, pp. 184-185), the best rubrics

1. Are sufficiently generic to relate to general goals beyond an individual performance task, but are specific enough to enable useful and sound inferences about the task.
2. Discriminate among performances validly, not arbitrarily, by assessing the central features of performance, not those that are easiest to see, count, or score.
3. Do not combine independent criteria in one rubric.
4. Are based on analysis of many work samples and on the widest possible range of work samples, including valid exemplars.
5. Rely on descriptive language (what quality or its absence looks like) as opposed to merely comparative or evaluative language, such as “not as thorough as” or “excellent product,” to make a discrimination.
6. Provide useful and apt discrimination that enables sufficiently fine judgments, but do not use so many points on the scale (typically more than six) that reliability is threatened.

7. Use descriptors that are sufficiently rich to enable student performers to verify their scores, accurately self-assess, and self-correct. (Use of indicators makes description less ambiguous, hence more reliable, by providing examples of what to recognize in each level of performance.)
8. Highlight judging the impact of performance (the effect, given the purpose) rather than over-rewarding processes, formats, content, or the good-faith effort made.

According to Wiggins, technical rubrics are

1. Continuous. The change in quality from score point to score point is equal: the degree of difference between a 5 and a 4 is the same as between a 2 and a 1. The descriptors reflect this continuity.
2. Parallel. Each descriptor parallels all the others in terms of the criteria language used in each sentence.
3. Coherent. The rubric focuses on the same criteria throughout. Although the descriptor for each scale point is different from the ones before and after, the changes concern variance of quality for the (fixed) criteria, not language that explicitly or implicitly introduces new criteria or shifts the importance of the various criteria.
4. Aptly weighted. When multiple rubrics are used to assess one event, there is an apt, not arbitrary, weighting of each criterion in reference to the others.
5. Valid. The rubric permits valid inferences about performance to the degree that what is scored is what is central to performance, not what is merely easy to see and score. The proposed differences in quality should reflect task analysis and be based on samples of work across the full range of performance; describe qualitative, not quantitative, differences in performance; and not confuse merely correlative behaviors with actual authentic criteria.
6. Reliable. The rubric enables consistent scoring across judges and time. Rubrics allow reliable scoring to the degree that evaluative language ("excellent," "poor") and comparative language ("better than," "worse than") is transformed into highly descriptive language that helps judges to recognize the salient and distinctive features of each level of performance.

Student assessment fits within the broad context of instructional design. The process begins with an instructional analysis to determine what teachers think they are doing, what they should be doing, their strengths and weaknesses, and what they think they are teaching and measuring. We used the learning standards as part of this process and helped teachers focus on what the state and nation prioritize for students to learn. We arranged this process in a variety of ways. Usually, we engaged teachers in the analysis at the beginning of the professional development program. Later, they followed through when participating in the performance assessment component. We modeled best practice in teaching and learning, and used standards, performance assessment, feedback, and rubrics to score the results. The workshop leader worked with teachers in a reiterative process that required a great deal of patience.

To support our teachers in this process, we gave them reference copies of several different sources. These varied according to the year and included the following: Marzano et al. (1993), *Assessing Student Outcomes, Performance Assessment Using the Dimensions of Learning Model;* McTighe and Arter (2001), *Scoring Rubrics in the Classroom;* Hart (1994), *Authentic Assessment;* Burke (1999) *How to Assess Authentic Learning;* and Bellanca et al. (1994), *Multiple Assessments for Multiple Intelligences*.

Developing teachers to the point where they can devise reasonably good and reliable performance tasks and rubrics means more than just teaching them the process; it requires embedding performance tasks within real-world problems and scenarios. Making this connection is very difficult for most teachers, especially those in mathematics and the sciences. It is much less difficult, and in fact more normal, for those in vocational areas or English disciplines. Therefore, MSTE teams benefited from working together on developing performance tasks and rubrics. Vocational teachers were a great asset when guiding mathematics, science, and English teachers to use and develop these more authentic and performance-based kinds of assessments (Tables 6, 7, and 8).

Table 12.6 Rubric for Assessing the Quality of a Performance Task

Key Components

A properly designed Performance Task must:

a. be based on content standards taken from the *Illinois Learning Standards*
b. describe a "real-life" scenario
c. involve students in complex reasoning processes
d. require students to collect and process information
e. incorporate "habits of mind"
f. require student collaboration and cooperation
g. result in a tangible product or communication activity

I. Component: The Performance Task is based on the *Illinois Learning Standards.*

1. The Performance Task is directly related to and based on Learning Standards.
2. Learning Standards are apparent, but the relation to the task is sketchy or irrelevant.
3. The Performance Task does not appear to be based on Learning Standards.

II. Component: A "Real-Life" scenario is described in the Performance Task.

1. The scenario described in the task accurately mirrors an activity in the community outside the classroom.
2. The scenario described in the task simulates an activity in the community outside the classroom.
3. The scenario described in the task contains some aspects of activity outside the classroom but is largely contrived.
4. The scenario described in the task is an academic exercise that usually takes place only in the context of a school setting.

III. Component: The Performance Task involves students in complex reasoning processes.

1. The task requires students to utilize complex reasoning components, such as induction/deduction, diagnosis, abstracting, experimental inquiry, or problem solving.
2. The task requires students to utilize complex reasoning components, such as comparing, classifying, decision making, or investigation.
3. The task requires students to only recall facts.

IV. Component: The Performance Task requires students to collect and process information.

1. The task incorporates a variety of information gathering techniques and information resources. Students are required to interpret and synthesize information and accurately assess the value of information gathered.
2. The task requires students to gather and synthesize information, but the value of the information gathered is not assessed.
3. The task requires students to gather information but not to interpret it.
4. The task requires no gathering or processing of information.

Table 12.7 Rubric for Assessing the Quality of a Performance Task (continued)

V. Component: The Performance Task incorporates "Habits of Mind."

1. The task requires students to make effective plans, use necessary resources, evaluate effectiveness of own actions, seek accuracy, and engage in activities when answers or solutions are not immediately apparent.
2. The task only requires students to effectively plan or use resources.
3. The task does not require students to engage in self-regulation, critical, or creative thinking.

VI. Component: The Performance Task requires student collaboration and cooperation.

1. The task requires students to use interpersonal skills, work toward the achievement of team goals, and perform a variety of roles within the team.
2. The task requires students to work together in teams, but there are no measures described that ensure collaboration or cooperation among team members.
3. The task is completed largely by students on an individual basis rather than in student teams.

VII. Component: The Performance Task results in a tangible product or communication activity.

1. The task result is a tangible product or communication activity comparable to that commonly produced in business or industry.
2. The task results in a product that is similar to those completed in business or industry but lacks several components that make the product realistic.
3. The task does not result in a product or communication activity.

Table 12.8 Rubric for Assessing the Quality of a Rubric

Key Components	
	A properly designed Rubric must:
	a. Contain a set of key components to be assessed.
	b. Include descriptors for each key component.
	c. Have descriptors that are indicative of observable student performance.
	d. Include appropriate weights for each component and descriptor (optional).
I. Component: The Rubric contains a set of key components to be assessed.	
Level	*Descriptors*
1	A complete list of key components is provided.
2	Key components listed are not exhaustive for the performance task.
3	Not all key components describe student outcomes.
4	No key components are listed.
II. Component: The Rubric includes a set of descriptors for each key component.	
Level	*Descriptors*
1	Descriptors for each component are arranged in a clear hierarchy from non-achievement to full-achievement.
2	Descriptors are present for each component, but obvious levels in some are missing.
3	Each component does not have an associated set of descriptors.
III. Component: Rubric descriptors are clear and contain observable student behavior.	
Level	*Descriptors*
1	All descriptors clearly delineate levels of student performance.
2	Most descriptors clearly delineate levels of student performance.
3	Only a few descriptors clearly define levels of student performance.
4	Descriptors do not describe observable student outcomes.
IV. Optional Component: Appropriate weights are assigned to components and descriptors.	
Level	*Descriptors*
1	Components and descriptors are each properly weighed according to instructional emphasis.
2	Weights are assigned, but point values do not reflect proper instructional emphasis in all cases.
3	Weights are assigned to some performance standards and descriptors.

Our teachers had already identified the student learning standards upon which they were going to base their integrated MSTE modules and had spent time with businesses and industries related directly to their modules. We began by reviewing their instructional analyses, the standards they wanted students to achieve, and then working with them on the development of the pretest/posttests, followed by the development of performance tasks. The performance tasks were embedded within real-world problems or scenarios, using their business, industry, and community learning experiences as a basis. After that, they designed their assessment instruments or procedures, including their tasks and rubrics, so that each module had several complex performance tasks (cluster of tasks) and corresponding rubrics. As mentioned above,

they had also developed a traditional pretest and posttest that was approved by the program leader and assessment expert.

The workshop covered assessment broadly, and then each type of assessment was explored more deeply, focusing on more authentic performance assessments, the scoring of performance tasks, and the creation of rubrics. The teachers developed the module's pretest and posttest with close assistance from the program leader. Bloom's Taxonomy was reviewed and used as a tool in the development process for all types of assessment. At each stage of this usually week-long course or workshop, the teachers developed assessment-related tools, so they were learning while performing and being simultaneously assessed through an interactive process of teaching, development, feedback, and evaluation between the leader (professor) and teacher.

This process was most effective when done over a four-day span, but we also tried it for five days and three days. Five days ensured greater understanding and skill development; three days was too short. Here is the agenda for a four- or five-day workshop:

- Day 1: Assessment Overview. Goal: Gain literacy in assessment and assessment strategies; identify the components of a balanced assessment model.
- Day 2: Portfolio Assessment. Goal: Identify the components and uses of portfolios; design a portfolio for the assessment workshop.
- Day 3: Traditional Assessment. Goal: Design teacher-made tests that are aimed at higher cognitive levels; build a database of test items to measure learning benchmarks for each content area; develop a team instrument to assess student accomplishment of module objectives (standards).
- Day 4: Performance Assessment. Goal: Identify assessment tools; design performance tasks.
- Day 5: Designing Rubrics. Goal: Develop skills in writing and using rubrics; design rubrics to assess student accomplishment of performance tasks.

Teachers received reference texts, a notebook with information from the presentations, performance task and rubric examples, the standards and achievement criteria for each one, and a rubric for scoring their performance tasks and rubrics. The leader reviewed the traditional tests for standards-based content validity. Teachers were also required to keep a reflective journal of their development, which had prompts for their responses. They produced an informal mini-portfolio, which provided evidence of their growth in student performance assessment and traditional test development.

Teachers responded extremely well when the workshops were led by a knowledgeable person who could answer their questions and help them make learning and assessment real. This required a leader with experience beyond a traditional classroom and who could use mathematics and science across real-world and other learning contexts. The most successful leaders came from technical disciplines (e.g., industrial technology, engineering technology). We had great success with teams co-led by a professor from engineering technology and a high school master teacher from technology education. However, the workshops were less successful when the program transitioned to the district, where local leaders took over. The traditional tests were not

as well conceived or developed, and the performance tasks were less authentic and much more basic, primarily due to lack of experience outside the classroom or with theory in action.

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Appendix

Accurately identifies constraints or obstacles

4 Accurately and thoroughly describes the relevant constraints or obstacles. Addresses obstacles or constraints that are not immediately apparent.

3 Accurately identifies the most important constraints or obstacles

2 Identifies some constraints or obstacles that are accurate along with some that are not accurate.

1 Omits the most significant constraints or obstacles.

Identifies viable and important alternatives for overcoming the constraints or obstacles.

4 Identifies creative but plausible solutions to the problem under consideration. The solutions address the central difficulties posed by the constraint or obstacle

3 Proposes alternative solutions that appear plausible and that address the most important constraints or obstacles

2 Presents alternative solutions for dealing with the obstacles or constraints, but the solutions do not all address the important difficulties.

1 Presents solutions that fail to address critical parts of the problem.

Selects and adequately tries out alternatives.

4 Engages in effective, valid, and exhaustive trials of the selected alternatives. Trials go beyond those required to solve the problem and show a commitment to an in-depth understanding of the problem.

3 Puts the selected alternatives to trials adequate to determine their utility.

2 Tries out the alternatives, but the trials are incomplete and important elements are omitted or ignored.

1 Does not satisfactorily test the selected solutions.

If other alternatives were tried, accurately articulates and supports the reasoning behind the order of their selection and the extent to which each overcame the obstacles or constraints.

4 Provides a clear, comprehensive summary of the reasoning that led to the selection of secondary solutions. The description includes a review of the decisions that produced the order of selection and how each alternative fared as a solution.

3 Describes the process that led to the ordering of secondary solutions. The description offers a clear, defensible rationale for the ordering of the alternatives and the final selection.

2 Describes the process that led to the ordering of secondary solutions. The description does not provide a clear rationale for the ordering of the alternatives, or the student does not address all the alternatives that were tried.

1 Describes an illogical method for determining the relative value of the alternatives. The student does not present a reasonable review of the strengths and weaknesses of the alternative solutions that were tried and abandoned

(Source: McREL Institute)

Figure 12.8 Problem-Solving Rubric (McRel Institute as cited in Huba & Freed, 2000, p. 191)

Is aware of own thinking.

4 Consistently and accurately explains in detail the sequence of thoughts he or she uses when faced with a task or problem, and provides analyses of how an awareness of own thinking has enhanced his or her performance.

3 Consistently and accurately describes how he or she thinks through tasks or problems and how an awareness of own thinking enhances his or her performance.

2 Sporadically but accurately describes how he or she thinks through tasks or problems and how an awareness of own thinking enhances his or her performance.

1 Rarely, if ever, accurately describes how he or she thinks through tasks or problems or how an awareness of his or her thinking enhances performance.

Is open-minded.

4 Consistently seeks out different and opposing points of view and considers alternative views impartially and rationally.

3 Is consistently aware of points of view that differ from his or her own and always makes a concerted effort to consider alternative views.

2 Is at times aware of points of view that differ from his or her own and sporadically makes an effort to consider alternative views.

1 Rarely, if ever, is aware of points of view that differ from his or her own and seldom makes an effort to consider alternative views.

Restrains impulsivity.

4 Consistently and carefully considers situations to determine if more study is required before acting; when further study is required, engages in detailed investigation before acting.

3 Consistently considers situations to determine whether more study is required before acting; when further study is required, gathers sufficient information before acting.

2 Sporadically considers situations to determine whether more study is required before acting; when further study is required, sometimes gathers sufficient information before acting.

1 Rarely, if ever, considers situations to determine whether more study is required before acting; when further study is required, usually doesn't gather sufficient information before acting.

(Source: McREL Institute)

Figure 12.9 Habits of Mind Rubric (McRel Institute as cited in Huba & Freed, 2000, p. 192)

Criteria	Levels of Achievement: Excellent (A) 4 points	Good (B) 3 points	Needs Improvement (C, D) 2 points	Unacceptable (F) 1 point
Formulation of Design Problem				
Formulation and scope of problem	Design problem formulation is clear and well thought out. The problem scope is well defined.	The problem formulation is clear, but the scope is not well defined.	The problem formulation is unclear in some respects and does not appear to be well thought out.	The design problem is not formulated clearly.
Significance	The problem chosen represents a current challenge facing the engine industry. The potential market is large and clearly identified.	The problem represents a current challenge in the engine industry, but the potential market is small or is not clearly identified.	The problem does not represent a current challenge in the engine industry, and the market is small or is not clearly identified.	The problem does not represent a current challenge in the engine industry. There is no explanation about who would be interested in the product or why they should buy it. There is no evidence of the background work (e.g., market analysis) that is needed to design an engine.

Continued

Figure 12.10 Rubric for Engine Design Project (Part 1) (McRel Institute as cited in Huba & Freed, 2000, p. 191)

Criteria	Levels of Achievement: Excellent (A) 4 points	Good (B) 3 points	Needs Improvement (C, D) 2 points	Unacceptable (F) 1 point
Engineering Skill Utilization				
Analysis	Engineering analysis is detailed and challenging and is used at every stage of the design process.	The engineering analysis is detailed and challenging, but some steps do not appear to be supported by calculations.	Some analysis is included, but it is not very detailed or challenging. Many steps are not supported by calculations.	Engineering analysis is infrequently used. When used, it appears trivial and leads to obvious conclusions.
Documentation	Documentation is thorough and complete.	There is some missing information in the documentation.	There is a great deal of missing information in the documentation.	Documentation is poor or nonexistent.
Assumptions	All assumptions are stated and justified.	Assumptions are stated, but some are not justified.	Assumptions are stated, but none are justified.	No assumptions are stated.
Extension of Knowledge about Internal Combustion Engines				
	Concepts beyond those in the prerequisite course are frequently used. The professor may have learned something new.	Prerequisite course content is used easily, and some material beyond the course is included.	Prerequisite course content is used, but new and unfamiliar areas are not introduced.	Prerequisite course content is not applied correctly. New areas are not included.

Figure 12.11 Rubric for Engine Design Project (Part 2) (McRel Institute as cited in Huba & Freed, 2000, p. 191)

Team Skills				
Group functioning	The group functions well. Peer review indicates good distribution of effort. All members are challenged and feel their contributions are valued.	The group functions fairly well. Some people in the group believe they are working harder (or less hard) than others, but everyone is contributing.	The group is still functioning, but each individual is doing his/her own work and ignoring the efforts of others. There are frequent episodes where one person's design will not fit with another's due to lack of communication.	The group functions poorly. All work is the product of individual efforts.
Regularity and productivity of meetings	The group meets regularly and the meetings are productive.	The group meets regularly, but meetings are not as productive as they could be. Some members are not prepared.	The group meets irregularly. Meetings are not as productive as they could be because several members are not prepared.	The group does not meet regularly, and when it does, some members are absent and no one is prepared.
Use of group problem-solving techniques	The group makes frequent use of brainstorming and group problem-solving techniques and documents the effect of these sessions.	The group uses brainstorming and group problem-solving techniques but does not always document the effect of these sessions.	Some attempt to use group problem-solving techniques is observed, but decisions are not based on results of problem-solving sessions.	No attempt to use group problem-solving techniques is made. Meetings are worthless.
Written Communication				
Organization	Written work is well organized and easy to understand.	The organization is generally good, but some parts seem out of place.	The organization is unclear.	The report is disorganized to the extent that it prevents understanding of content.
Definition of terms	All new terms are defined.	Some terms are used without definition.	Many terms are used but not defined.	Terms are used without definition to the extent that understanding is inhibited.

Continued

Figure 12.12 Rubric for Engine Design Project (Part 3) (McRel Institute as cited in Huba & Freed, 2000, p. 191)

	Levels of Achievement			
Criteria	**Excellent (A) 4 points**	**Good (B) 3 points**	**Needs Improvement (C, D) 2 points**	**Unacceptable (F) 1 point**
Integration of writing styles	The team developed a writing style that is uniform throughout the report. There is no indication that the report involved multiple authors.	There is some indication of multiple authors (e.g., different fonts, different paper, etc.).	There is ample indication of multiple authors (e.g., different fonts, different paper, etc.)	Report is clearly the work of multiple authors with different writing styles, margins, printer fonts, and paper types.
Grammar	The work has been thoroughly spell-checked and proofread by everyone in the group.	There are a few spelling and grammatical errors.	There is more than one spelling or grammatical error per page.	There are frequent misspelled words and serious grammatical errors, indicating that time was not taken to spell-check and proofread.
Use of appendices	Information is appropriately placed in either the main text or an appendix. Appendices are documented and referenced in the text.	Information is appropriately placed in either the main text or an appendix. Documentation and referencing in text are somewhat incomplete.	There is some misplacement of information in the text vs. the appendix. Appendices are poorly documented and referenced in text.	Considerable amount of material is misplaced. Appendices are not documented or referenced in text.

Figure 12.13 Rubric for Engine Design Project (Part 4) (McRel Institute as cited in Huba & Freed, 2000, p. 191)

Oral Communication

Interest/organization	Design presentation is clear, interesting, and well organized. It starts and ends well.	The design presentation is interesting, but some points are unclear. The introduction and/or conclusion are weak.	The design presentation has some interesting points but is difficult to follow. Either the introduction or conclusion is missing.	The design presentation is hard to follow and poorly organized. It appears to be off-the-cuff. There is no introduction or conclusion.
Visual aids	Visual aids are used frequently. They are easy to read and understand, and they are of professional quality.	Visual aids are good, but a few are sloppy or difficult to read.	Most visual aids are sloppy and hard to read.	There are too few visual aids, and those used are carelessly prepared.
Length	The presentation is within the assigned time limits.	The presentation is too short or too long by two minutes or more.	The presentation is too short or too long by five minutes or more.	The presentation is too short or too long by ten minutes or more.
Engineering analysis	Engineering analysis is presented with sufficient detail to be understood, but not so that it insults the audience.	Engineering analysis is poorly explained or so detailed that the audience falls sleep.	Engineering analysis consists of trivial calculations and is poorly explained.	No engineering analysis is presented.

(Van Gerpen, 1999)

Figure 12.14 Rubric for Engine Design Project (Part 5) (McRel Institute as cited in Huba & Freed, 2000, p. 191)

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NORTHERN ILLINOIS UNIVERSITY

April 24, 2007

Connecting Accreditation Outcomes to Student Learning Outcomes
Teaching Models and Styles
Traditional Test Development
Performance Tasks & Rubric Development
Course Development
Student Learning Styles
Super Syllabus
Educational Research
Experimental Research in the Classroom
Research Manuscript Preparation

Dr. Promod Vohra
Dean, College of Engineering & Eng Technology

Dr. Raymond Alden III
Executive Vice President & Provost

Dr. Jule Dee Scarborough
Distinguished Professor & Program Leader

Faculty Participants

Abul Azad
Brian Coller
Abhijit Gupta
Reinaldo Moraga
Ibrahim Abdel-Motaleb
Regina Rahn
Robert Tatara

I Love Teaching at NIU

NORTHERN ILLINOIS UNIVERSITY

Volume II: Research and Evaluation Data Reports

The Scholarship of Teaching
The CEET Initiative on Teaching and Learning

Jule Dee Scarborough, Initiative Director

College of Engineering and Engineering Technology
Promod Vohra, Dean

Program Associate: Jerry Gilmer, Director, NIU Testing Services
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October 2005-December 2006

PORTFOLIO SUMMARY COMMENTS
Jule Dee Scarborough, Ph.D.
(See Tables 1 and 2 below)

The Portfolio Assessment Chart below reveals that all professors except one completed all aspects of the program and research semester successfully. That means that each of those seven professors completed the faculty development program of learning with significant gain in learning. Seven professors completed all teaching and learning products during the faculty development program; and all seven professors fully participated in the research semester, executing experimental research in the classroom with their students. All seven professors prepared a research manuscript and submitted it for publication. However, one of the seven professors did not complete some activities as planned; he/she did not diagnostically analyze the final examination and did not use the second and third performance assessments as planned. That individual did complete the research as planned but did not implement the full range of changes prepared and planned for the 2006 course. This culminating assessment, college portfolio, provides evidence that the program was very successful, resulting in significant change and a new range of teaching and learning activities for each professor. The portfolio also reflects each professor's preparation for the research semester, itemizing the products developed and used during the 2006 experimental research semester. Generally, the portfolio chart reveals the results of the faculty development program and research semester and documents the professors' learning and progress toward new teaching and learning strategies, as well as that toward the Scholarship of Teaching.

Table B.0.1:Teaching Portfolio Assessment Chart, January 28, 2007- CITL Faculty Development Program

Portfolio Product (Artifact) Content (See Sections of information following this summary)	**RM**	**RR**	***AA**	**BT**	**IM**	**BC**	***AG**
Self Assessment Baseline: 1.____Student Questionnaires (f05 & f06) 1.____Professor completion(s) of Student Questionnaire (f05 &f06) 2.____Professor completions of Self Competency Questionnaire (Feb.06, May06, Dec.06) **3.**____Program Components Assessments (8) 4.____Standard Departmental Course Evaluations (f05 & f06) 4.____ Student Grades & End of Semester Grades (f05 & f06)	√	√	√	√	√	√	√
5. Course Analysis: 5a1._Course Outline, Embedded Gen Ed, Content Priorities 5a2._Course Content Analysis by TM,TS, LS, Bl, Dale, etc. 5b. _ Instr. Design GAPS Analysis on- TM, TS, LS, B, D 5c. _ Instructional GAPS Summary 5d. _ ABET/TAC/NAIT SLO by Bloom's Analysis 5e. _ Course Content Schedule 5f._ Teaching Models + Cooperative Learning + Study Chart + TM graphic 5g._ Course Calendar by TM, TS, LS, B, D	√	√	√	√	√	√	√
*****Student Learning Styles Inventory:*** (NOT REQUIRED)** Kolb (Extra professional effort on part of professors) Felder (Extra professional effort on part of professor)	K√	K√	NA	NA	NA	F√	NA
Multifaceted Assessment System: 5h.__ Multifaceted Assessment Plan Graphic, showing course assessments 5i. __Test and Test Items by SLO Chart 5j.__Assessment Analysis by Bloom (Chart)	√	√	√	√	√	√	√
6. Traditional Objective Tests:: _____Test Analysis (Midterm and Final Exam) _____Table of Specifications (not included) _____Test Item Bank (not included) 7.____New Midterm Exam 7.____New Final Exam 8. ___ Diagnostic Write Ups (MT & F)	√	√	√	√	√- Partial Midterm Analysis X No analysis for Final Exam X Diagnostics No Analysis in Report	√	√
Performance Assessment & Rubrics: 7. _____ 3 Complex Performance Assessments with multiple tasks embedded 7._____3 Rubrics, one to score each Performance Assessment (And to be used with students to establish standards up front) 8._____ Diagnostic Write Ups (PA 1,2,3) *_____ Copies of Students Rubrics (Hardcopies on file) 7._____ Electronic copies of tests and PAs & Rubrics **Other Assessments of Individual Choice: Yes for All**	√	√	√	√	√-Partial Did not seem to use PA 2,3 X	√	√
9. Student Centered Course Syllabus: _____All new components and check off list	√	√	√	√	√	√	√
10. Professors' Research: **____ Completed Data Forms (including data on MT, F, PA1,2,3)** **____ Research Results Reports**	√	√	√	√	Partial √Midterm x No Final- Rubrics √	√	√
12.___Teaching Portfolio Assessment Questionnaire **13___ Teaching Models Self Assessment** **14___ Teaching Styles Self Assessment** **15___ Student Learning Style Opportunities Assessment** **16___ Outcomes Achieved as Planned by Bloom & Dale Assessment**	√	√	√	√	√	√	√
17. Manuscript to be submitted: **_____ Draft** **_____ Final Version to be submitted to journal (May, 2007)**	√	√	√	√	X ☺ Final Report, not article	√	√

Legend: √ = okay X = still needed ☺ = not due yet

Table B.0.2: Teaching Portfolio Assessment Questionnaire, May 25, 2006 – CITL Faculty Development Program

Portfolio Product (Artifact) Content	**Description of my Knowledge, Skills, Abilities on Feb. 2, 2006**	**Description of my Knowledge, Skills, Abilities on May 25th, 2006**
Self Assessment Baseline: _____Student Questionnaire _____Professor completion of Student Questionnaire _____Professor Self- Competency Questionnaire	**1. "Did not do the questionnaire before."**	**1."These questionnaires provided me with a tool to gauge the difference between my perception about the course and how the students see the course, regarding the course goal, delivery, teaching effectiveness, objectives, etc."**
	2. "The syllabus was not detailed and objectives were not spelled out in detail. Testing and measurement needed to be improved (there were no performance tasks, rubrics, etc.) Students and I were not aware of various Teaching and Learning Methods. There was not much scope of Cooperative and Group Learning."	**2a. "Syllabus now has much more detail, including SLO, NIU Gen Ed, ABET standards and assessments. b. New tests are more objective and also many different types of questions, Performance Tasks have been added. c. Became aware of various learning and teaching methods. d. Cooperative and group learning will take place."**
	3a. "Most elements were missing. I was not convinced of the value of many elements. b. Before, I had taken much of the "burden of teaching the material to students."	**3a. "Most elements are in place. They are valuable. I expect students to recognize them. b. I'm shifting the burden dramatically."**
	4. "I was in very bad shape."	**4. "I hope, and I think so; I will improve."**
	5. No comment	**5. No comment**
	6. "Good knowledge from student evaluations. Useful to change course and adapt to student comments."	**6."Better, more detailed knowledge; much more of a quantitative approach; easier to compare data to previous courses."**
	7. "I was unaware of teaching models and learning style inventories. I also did not have a very comprehensive syllabus. This was evident by the responses to all of the questionnaires."	**7. I did not know how the students would respond in their questionnaire at the end of the next semester. However, I know that my responses to both the Student and Self-competency questionnaires were extremely different. I now have a level of confidence in both content and terminology related to teaching."**

Course Analysis: _____GAPS Analysis on- TM, TS, LS, B, D _____ABET/TAC /NAIT SLO by Bloom's Analysis _____Course Calendar by TM, TS, LS, B, D _____Teaching Models + Cooperative Learning + Mapping Study Chart	**1. "Was not familiar with these issues."** **2a. "For GAPS analysis, most of the terminologies were not very clear and consequently answers sometimes were more of a guess."** **b. ABET SLO by Bloom's analysis reflected more of lower level of learning.** **c. Course calendar had only topics listed by weeks but not TM, TS, etc. Also, again, many of these terms were either not very clear or not thought of in terms of their implementation in the context of my course."** **c. There was not chart for Teaching Models + Cooperative Learning, etc."** **3."In other courses, I had used many different learning and teaching styles, and many more assessments. However, I have been putting off the task of doing this with [this course].** **b. Was familiar with Bloom & Dale; was familiar w/Felder's LS Taxonomy.** **c. I had never created such a detailed calendar;** **d. Connections to ABET were weak."** **4a. "I had a little knowledge on this matter. I knew I had to connect my course objectives with ABET outcome, but I was not clear how to do this. I had no idea about teaching models."** **5a. "Did not know much about this;** **b. Knew about the ABET outcomes and associated details, but did not know about Bloom's Analysis;** **c. Did not have a course calendar before;** **d. Did not think much about TM, CL, and mapping."** **6. "No knowledge previously, but many components of techniques and models already utilized in classroom."** **7. "As evidenced by my courses analyses, I was lacking in the implementation of learning styles, teaching models, and teaching styles, as well as having a course calendar. There was much opportunity for improvement. I had no relationship at all between course activities, assessments, active learning, and Bloom's Taxonomy. My student learning objectives were very general and were not directly related via a matrix to ABET outcomes."**	**1. "Realized the importance of GAPS analysis, SLOs, teaching models,…etc. and how they can be used to enhance the learning process."** **2. "Course analysis is more detailed. The terminology is clearer and hopefully future GAPS analyses would reflect that.** **b. ABET SLO by Bloom's Analysis not only are more detailed, but they reflect higher level of learning.** **c. Course calendar has more details to include TM,TS, etc.** **d. Teaching Models + Cooperative Learning, etc. chart makes us not only realize what these models mean, but also their strengths and weaknesses and whether they are applicable for my course."** **3. "Class formalized much knowledge in these areas. Reading gave labels to much of what I was doing, provided more of a scientific foundation.** **b. I know exactly where I can go (or begin going) to look stuff up, foundations mostly.** **c. Much stronger** connections to specific learning outcomes." **4a. "I feel really strong in doing this connection – my course objectives & ABET outcomes.** **b. Now I know different teaching models.** **c. I feel I have gained new tools to research."** **5a."Did GAP Analysis, but need to revisit the item; make its proper use;** **b. Linking ABET outcomes and SLOs with Bloom's is a good exercise. It helps to plan for level of teaching for each of these SLOs and their connection with ABET Outcomes. This will also help to develop ABET documentations.** **c. Course calendar will provide some guideline towards course delivery. However, there may be some time when it will be difficulty to follow it exactly.** **d. Understanding of teaching models and their links with various learning styles, along with the cooperative learning is very helpful."** **6."Good understanding of topics, actual application to current course. Studied a variety of models from different sources."** **7. I have made a concerted effort to look at incorporating different teaching styles and models, as well as learning styles into my courses, and I am committed to trying them during the next semester. My student learning objectives are now written with specific goal s in mind. There is also a direct correlation between them and ABET (and GEN ED) outcomes. The greatest impact I believe has been in the addition of active learning/Bloom's concepts into my course preparation. It has proven to be a truly eye-opening experience. I will definitely continue with these principles in all of my future courses."**

Student Centered Course Syllabus: _____All new components and check off list	**1. "My syllabus was ok, but not excellent."** **2."The syllabus was not detailed and objectives were not explained in detail. It just followed the format that is minimum required by ABET but without the details (e.g. , SLO)."** **3a. "Had never listed as much detail, never listed SLOs;** **b. Had never had fixed grading scale."** **4. "I had the opportunity to participate in syllabus workshop in [last institution], so I was aware of this."** **5. "Past course syllabus was detailed but did not have all the SLOs written clearly."** **6."Good knowledge of syllabus construction with much pertinent information given."** **7. "My past syllabus was not comprehensive. Many components were lacking. The SLOs [student learning outcomes] were not specific and I did not have a checklist."**	**1. "Syllabus is much better because it cannot guide me and the students through the course delivery. The syllabus gives the students a full picture of what is expected from them to achieve the grade they want."** **2. "Syllabus now has much more details, including SLO, NIU Gen Ed, ABET standards, and assessments."** **3a. "Can use SLO in syllabus as advanced organizer.** **b. Grading is much more clearly defined; less ambiguity.** **c. new syllabus is better for meta-cognition.** **d. Students better able to assess their progress."** **4. "I feel the way I was using my syllabus in the past was right, but now I have improved in the course schedule part."** **5. "Course syllabus is now much improved with detailed SLOs."** **6a."Improved syllabus design with much more tangible and constructive information for the student.** **b. Students will know course requirements and grading policy."** **7. "My new syllabus looks like a new species as compared with the old one. It gives the students much more information, especially in regard to expectations. The SLOs are spelled out and related to ABET. I have incorporated many new components, including the checklist. There has been an enormous leap forward. The final product is very different, but more importantly I now have an understanding of the components behind the syllabus."**

Multifaceted Assessment System: _____Course Assessment Plan Chart showing course assessments _____Assessment Analysis by Bloom (Chart) **Traditional Objective Tests:** _____Test Analysis _____Table of Specifications _____Test Item Bank _____New Midterm Exam _____New Final Exam _____Test Items by SLO Chart **Performance Assessment & Rubrics:** _____ 3 Complex Performance Assessments with multiple tasks embedded _____3 Rubrics, one to score each Performance Assessment (and to be used with students to esta-blish standards up front)	**1. "Was not familiar with charts, test [analysis & development], performance [tasks] and rubrics."** **2a. "No multifaceted chart and Assessment analysis by Bloom was prepared."** **b. Tests were not objective. There was not table of specifications. Exam questions were only of one type.** **c. There were no performance assessments."** **3a. "Gave mostly long problems, subjectively scored with five quizzes before."** **b. My number of major assessments was relatively high. However, I did not have performance items in the same way that I have now. Not as deep (Blooms).** **c. Assessment problems were not necessarily distributed well over the learning objective;** **d. I had a few multiple choice items, but not enough to form a broad assessment of understanding."** **e. Never had a high level performance in [this course] before.** **f. Never had detailed rubrics for scoring reports.** **g. Never thought of having students score themselves w/rubric.** **h. In class group work in big lecture was weak."** **4a. "I barely knew anything about Bloom's Taxonomy."** **b. My knowledge on this matter was really poor.** **c. I didn't know anything about this."** **5a. "Did not have an assessment chart before;** **b. Did not have any assessment analysis by Bloom's;** **c. Did not have any test analysis before;** **d. Did not have any table of specification;** **e. There was no test item bank;** **f. Did not use many objective tests for midterm or finals.** **g. Have used performance test before [but not formally written as performance tasks];** **h. Used rubrics in limited way."**	**1a. "Charts will help students connecting the different learning activities to be able to visualize the full picture of the learning abilities."** **b. "Tests became a more accurate tool of assessment that can be used to gauge students' performance, since the tests can be related to SLOs."** **c. "Performance assessments provide alternative means to assess the students' performance and ensure fair grades in the course."** **2a. "No only these charts were prepared, but the chart showed how many different ways a student can be assessed.** **b. New exams are more objective and have various types of responses. They also are designed to test various levels of learning.** **c. Three performance assessments and rubrics were made. These performance tasks consequently involve much higher level of learning and also certainly involve active learning (instead of mostly passive)."** **3a. "Much better Balance --problem types, conceptual vs. putting all pieces together vs. creating something.** **b. Well defined rubrics for subjective problem tests.** **c. Now they are** **d. Now I do."** **e.f.g. Now I do.** **h. Will be stronger; will be assessed; will require students to prepare."** **4a."Definitely, I know much more now. I really think that the assessment map is a very good tool that will allow me to assess myself – where I am.** **b. I feel I know, and understand now, that there are multiple ways to assess students.** **c. I know how to construct a performance task and rubric. I think this is just the beginning, but at least I know where to start from."** **5a. "Assessment chart is quite helpful to see the total assessment process for the course;** **b. Assessment analysis by Bloom shows the level of performance that students are going to perform for each of the assessment methods.** **c. Test analysis provides in-depth understanding while designing and improving a test;** **d. Item bank is very helpful from where one can pick required tests items at desired level of Bloom;** **e. In addition to developed midterm and final, I may need to add some subjective test items.** **f. Developed performance tests provide broad range of assessment;** **g. Rubrics will be very helpful both for the students and for the faculty."**

	6a."Limited to very low knowledge in these areas. b. Very good knowledge in test construction, but no quantitative, statistical analyses [before now]." c. Very good previous knowledge in assessments and scoring rubrics; Scoring rubrics already extensively utilized in courses."	6a."Ability to execute charges and to rank assessment activities by creativity and active versus passive learning processes. b. Analytical tools useful for critical and detailed assessment of test questions. Valuable test bank that connects individual test questions with student learning objectives and outcomes. c. Able to expand performance tasks to higher Bloom's comprehension levels with a more active approach for the student. Included more group learning. Able to fine tune rubrics for assessment performance tasks."
CONTINUE: Multifaceted Assessment System: ______	7. "I did have multiple assessment types prior to this workshop. However, I did not know exactly what the terminology and importance of each one was. My traditional tests were mainly 'short answer' or 'essay'. I had never before performed a 'test analysis'. The analysis of my past tests did show that I was testing what I wanted to test, and the difficulty was where I wanted it to be. I do not want that to change in the future. I did not have my test items written/grouped by SLOs." "I had incorporated complex performance assessments with multiple embedded tasks. However, I was not using this terminology. I also did not use rubric scoring, although I was aware of this technique."	7. "I created a chart of the assessments to be used in the next semester. I have included more than I had in the past. Group discussion will now be assessed, rather than just performed. The students will know what they have to do because of the rubric scoring." "I rewrote my midterm and final exam to be much more 'objective' in nature, including questions that are multiple choice, true/false, etc. I am not confident this will sit well with the students. I believe that short answer problem solving types of questions are still objective, but they give the students the opportunity to use their own approach to come up with the 'correct' answer. I will try the new tests and see what happens. I will definitely use the test analysis during the next semester. I will use this in all of my classes." "I created three new performance assessments and corresponding rubrics. This area excites me the most because I can see where the students will be reaching the upper levels of Bloom's. I can also have group discussions surrounding the PAs, where many more teaching models can be used. I see this as a new door being opened. I am anxious to see the outcomes next semester. I believe that the rubrics are key to the success of proper assessment of performance type tasks. I hope the students will also see the value in knowing my expectations of them."
Other Assessments of Individual Choice: **List and Describe Here:**		

Teaching Portfolio Assessment Chart Form, DATE - CITL Faculty Development Program

Portfolio Product (Artifact) Content (See Sections of information following this summary)	Faculty Member				Faculty Member		
Self Assessment Baseline: 1.____Student Questionnaires (f05 & f06) 1.____Professor completion(s) of Student Questionnaire (f05 &f06) 2.____Professor completions of Self Competency Questionnaire (Feb.06, May06, Dec.06) **3.**____Program Components Assessments (8) 4.____Standard Departmental Course Evaluations (f05 & f06) 4.____ Student Grades & End of Semester Grades (f05 & f06)							
5. Course Analysis: 5a1._Course Outline, Embedded Gen Ed, Content Priorities 5a2._Course Content Analysis by TM,TS, LS, Bl, Dale, etc. 5b. _ Instr. Design GAPS Analysis on- TM, TS, LS, B, D 5c. _ Instructional GAPS Summary 5d. _ ABET/TAC/NAIT SLO by Bloom's Analysis 5e. _ Course Content Schedule 5f._ Teaching Models+Cooperative Learning+Study Chart+TM graphic 5g._ Course Calendar by TM, TS, LS, B, D							
*****Student Learning Styles Inventory:*** (NOT REQUIRED)** Kolb (Extra professional effort on part of professors) Felder (Extra professional effort on part of professor)							
Multifaceted Assessment System: 5h.__ Multifacted Assessment Plan Graphic, showing course assessments 5i. __Test and Test Items by SLO Chart 5j.__Assessment Analysis by Bloom (Chart)							
6. Traditional Objective Tests:: _____Test Analysis (Midterm and Final Exam) _____Table of Specifications (not included) _____Test Item Bank (not included) 7.____New Midterm Exam 7.____New Final Exam 8. ___ Diagnostic Write Ups (MT & F)							
Performance Assessment & Rubrics: 7. _____ 3 Complex Performance Assessments with multiple tasks embedded 7._____3 Rubrics, one to score each Performance Assessment (And to be used with students to establish standards up front) 8._____ Diagnostic Write Ups (PA 1,2,3) *****_____ Copies of Students Rubrics (Hardcopies on file) 7._____ Electronic copies of tests and PAs & Rubrics **Other Assessments of Individual Choice: Yes for All**							
9. Student Centered Course Syllabus: _____All new components and check off list							
10. Professors' Research: **____ Completed Data Forms (including data on MT, F, PA1,2,3)** **____ Research Results Reports**							
12.___Teaching Portfolio Assessment Questionnaire **13___ Teaching Models Self Assessment** **14___ Teaching Styles Self Assessment** **15___ Student Learning Style Opportunities Assessment** **16___ Outcomes Achieved as Planned by Bloom & Dale Assessment**							
17. Manuscript to be submitted: **_____ Draft** **_____ Final Version to be submitted to journal (May, 2007)**							

Legend: √ = okay X = still needed ☺ = not due yet **See Result**

PROFESSORS' SELF PERCEPTIONS OF COMPETENCY

Jule Scarborough, Ph.D. and Jerry Gilmer, Ph.D.

A twenty-five item survey was developed to determine the professors' self assessment of their competency levels in the main areas covered during this project: Analysis, Assessment, Methods, and Research (Scarborough, 2006). The survey was administered three times during the project: immediately prior to the beginning of the formal teaching sessions, immediately after the conclusion of the formal teaching sessions, and at the end of the semester during which the professors where practicing the concepts learned. Each item was worth 4 points for a maximum total of 100 points. The table below contains the self competency scores for the professors for each content area and each administration of the survey.[1] See Questionnaire in B.1.a and C.2

Table B.1.1

Content Area:	**Analysis**		**Assessment**		**Methods**		**Research**		**Total**	
Max. Score:	**36**		**32**		**24**		**8**		**100**	
Admin 1 (2/2/06)										
Abdel-Motaleb	18	50%*	11	34%	10	42%	3	38%	42	42%
Azad	26	72%	22	69%	12	50%	5	63%	65	65%
Coller	21	58%	17	53%	14	58%	4	50%	56	56%
Gupta	19	53%	20	63%	11	46%	4	50%	54	54%
Moraga	12	33%	13	41%	6	25%	3	38%	34	34%
Rahn	21	58%	23	72%	11	46%	4	50%	59	59%
Tatara	23	64%	18	56%	16	67%	6	75%	63	63%
Admin 1 mean	20	20%	18	18%	11	11%	4.1	4%	53	53%
Admin 2 (6/16/06)										
Abdel-Motaleb	24	67%	21	66%	18	75%	4	50%	67	67%
Azad	32	89%	27	84%	19	79%	7	88%	85	85%
Coller	30	83%	30	94%	21	88%	7	88%	88	88%
Gupta	32	89%	27	84%	18	75%	6	75%	83	83%
Moraga	29	81%	24	75%	16	67%	6	75%	75	75%
Rahn	33	92%	32	100%	20	83%	6	75%	91	91%
Tatara	33	92%	31	97%	21	88%	7	88%	92	92%
Admin 2 Mean	30	30%	27	27%	19	19%	6.1	6%	83	83%
Admin 3 (12/15/06)										
Abdel-Motaleb	25	69%	25	78%	21	88%	7	88%	78	78%
Azad	30	83%	27	84%	17	71%	7	88%	81	81%
Coller	31	86%	29	91%	21	88%	7	88%	88	88%
Gupta	29	81%	30	94%	17	71%	6	75%	82	82%
Moraga	30	83%	29	91%	17	71%	7	88%	83	83%
Rahn	34	94%	32	100%	18	75%	7	88%	91	91%
Tatara	28	78%	26	81%	18	75%	6	75%	78	78%
Admin 3 Mean	30	30%	28	28%	18	18%	6.7	7%	83	83%

* Interpretation: A score of 18 is 50% of the maximum possible score of 36 for Analysis.

[1] The items from the survey contributing to the score for each content area are Analysis - 1, 2, 3, 7, 9, 16, 20, 23, 25; Assessment - 4, 5, 6, 8, 10, 11, 12, 13; Methods - 14, 15, 17, 18, 19, 21; Research - 22, 24.

The differences between the content area means across the different administration times were analyzed statistically and the results are presented in the table below. The significance levels are from paired samples t-tests on the data from seven professors (df = 6).

Table B.1.2

	Means			**Difference: Admin 2 - Admin 1**		**Difference: Admin 3 - Admin 1**	
Index	Admin 1 (2/2/06)	Admin 2 (6/16/06)	Admin 3 (12/15/06)	Difference	**Sig. Level**	Difference	**Sig. Level**
Analysis (36)**	20.0	30.4	29.6	10.4	**0.000**	9.6	**0.002**
Assessment (32)	17.7	27.4	28.3	9.7	**0.000**	10.6	**0.000**
Methods (24)	11.4	19.0	18.4	7.6	**0.000**	7.0	**0.001**
Research (8)	4.1	6.1	6.7	2.0	**0.001**	2.6	**0.003**
Overall (100)	53.3	83.0	83.0	29.7	**0.000**	29.7	**0.001**

** - The number in parentheses is the maximum score for the index.

The data in the table indicate that the professors' increase in self competence from the first administration to the second was statistically significant and that the increase remained strong, and statistically significant, several months later after the professors were able to practice the concepts in their own classrooms.

Point value for each item is from 1 to 4 – the same as the response labels. Maximum possible points = 100.

COMPETENCY SELF ASSESSMENT
CEET INITIATIVE ON TEACHING AND LEARNING
Jule Dee Scarborough (2006)

Please respond to each question about the level of knowledge, skill, and confidence you feel you have:

1. Design and develop courses where student learning objectives and outcomes are clear and distinctly different.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

2. Designing and developing a logical and organized course where course syllabi are structured such that students fully understand what is to happen for the entire semester; where the syllabus is the course map for both myself (professor) and the students; and where the syllabus provides all information about objectives, course content, timeline, course requirements, student learning assessments (tests, projects, etc.) grading structure and criteria, etc.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

3. Providing learning activities that align with the syllabus and course content identified in the syllabus; adhering to the timeline in the syllabus; and leading student learning without significant distractions or deviations unrelated to content where each lesson and learning activity are directly related and add value; where no unplanned, last minute, or major assignments not identified on the syllabus are imposed upon students unexpectedly.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

4. Designing a total student assessment system where there is a great variety of types of student learning assessment, tests, quizzes, case studies in industry, literature studies, research, papers or other writing assignments, projects, presentations, portfolios, etc.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

5. Designing student assessments that directly align and measure knowledge and/or skills itemized on course syllabi.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

6. Implementing a student learning assessment strategy throughout the course where feedback on all student assignments, or learning assessments is immediate (or reasonably timed – e.g., 2 weeks); in other words, students receive feedback from the professor on grades or scores for tests, projects, etc. that can be considered immediate in the university schedule context (e.g., 1-3 classes later).

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

7. Designing and developing instruction using Bloom's Taxonomy of levels of learning where the upper levels of Bloom's are achieved many times throughout the course (e.g., levels-knowledge, comprehension, application, synthesis, analysis, and evaluation).

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

8. Designing and developing student learning assessments (e.g., tests, performances) using Bloom's Taxonomy of levels of learning where the upper levels of Bloom's are achieved many times throughout the course (e.g., levels-knowledge, comprehension, application, synthesis, analysis, and evaluation).

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

9. Developing a course using the "reversed design" process.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

10. Designing and developing traditional tests that directly measure what students are responsible for learning from professors and other sources or activities identified in the syllabi; where the items are an adequate sample of the content domain and the item types are appropriate to the purposes of the test; where the items require thinking at the upper levels of Bloom's Taxonomy; where the scoring and grading procedures are transparent to the student and as objective as possible; where each item can be traced directly back to the standards, student learning objectives, text and source information, and learning experiences.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

11. Performing test analysis involving statistical analysis of students' responses; obtaining item statistics for judging and improving the quality of individual items and for judging and improving the quality of instruction.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

12. Developing student performance tasks to measure what students can do with knowledge; where there is a direct link to traditional tests that move student learning assessment from “knowing about” to “performing or doing-using knowledge”; where the upper levels of Bloom’s Taxonomy or levels of learning are demonstrated.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

13. Designing and developing rubrics for the purpose of scoring (grading) student performances that measure "learning by doing" where students demonstrate what they know by using knowledge to perform a task, etc.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

14. Designing and developing a course where many different teaching models are used throughout the course (e.g., lecture, direct instruction, reciprocal, reciprocal-performance, mastery learning, graphic organizers, concept attainment, conceptualization, inductive thinking, deductive thinking, concept formation, inquiry, training, synectics, psychomotor, metaphorical, non-directive, role play, cooperative/collaborative, etc.).

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

15. Designing and developing a course where many different teaching styles are used throughout the semester (e.g., command, practice, self-check, inclusion, guided discovery, convergent discovery, divergent production, learner-designed, learner-initiated, self-teaching styles).

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

16. Designing and developing a course that accommodates different learning intelligences and student learning styles as "characteristic of the cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" or "the way each learner begins to concentrate, process, and retain new and difficult information" or "concrete experience, reflective observation, abstract conceptualization, active experimentation."

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

17. Designing and developing a course where the burden of learning is on the student rather than the professor; where the professor assumes instructional leadership and directs student learning but is not entirely responsible for “imparting” <u>all</u> the knowledge to be learned “directly”; where students actively engage in their own learning; where lecture is <u>not</u> KING. BE HONEST!

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

18. Designing and developing student learning activities where "cooperative" or "collaborative" learning models are used formally; where "informal," "formal," or "base" structures are used based upon Kagan or Johnson and Johnson strategies throughout the course or for major learning activities.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

19. Designing and developing student learning activities where cooperative learning in small groups provides the opportunity for students to experience accomplishing a goal together; where students would feel that they are gaining self-esteem and respect from others, that they are learning more because they are learning with others, that the experience raised everyone's learning and consequently their grades; where higher level thinking occurs because of students engaging in inquiry together and asking questions of each other; where social skills develop as an outcome; and where they increase their capacity to cope with stress or adversity – especially where group learning is designed with performance criteria and where they were trained or educated about group behavior or dynamics.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

20. Designing and developing learning activities where multiple intelligences are required for learning.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

21. Designing and developing problem-based learning where students are assigned a problem with conditions, constraints and/or possibilities that require materials (sometimes), research, and/or collaboration; where students have to take responsibility for their own learning by solving the problem; where the problem crosses the boundaries of disciplines, entwining theory and practice; where there is a focus on the processes of knowledge acquisition rather than the products of such processes; where the professor is a facilitator rather than instructor; and where students will engage in self and peer assessment.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

22. Engaging in the scholarship of teaching, research in the classroom on teaching and student learning using appropriate research design and methodology, analytical or statistical procedures, etc.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

23. Using course evaluation data or information as feedback to determine course changes.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

24. Evaluating the effectiveness of "interventions" or course changes to improve student learning.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

25. Closing the feedback loop and actually make course changes for the purpose of improving student learning.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

COMPARISON EVALUATION AND SUMMARY
FALL 2005 → FALL 2006
(See Portfolio Sections A.5)
Jule Dee Scarborough, Ph.D.

Overall, the original syllabi for the baseline courses, Fall 2005, were in need of categorical additions and other improvements. For example, when reviewing the Summary Chart, there are very few schedules of topics, course activities, assessments, due dates; there is also no mention of items such as self-check lists, general education goals, course purpose, lab notes, faculty policies or expectations, professor's roles and responsibilities, or that of the students, course references, support services, and/or grading values. Although individuals varied in their approaches and syllabus content, for the most part, there were gaps between the model syllabus, which was an example that reflected what the literature would identify as a super syllabus and the professors' syllabi. A super syllabus is one where all important information is available so students can understand: exactly what they are going to learn about and do, the assessments and/or requirements, the course schedule, timelines or due dates, all expectations, and more. It is important to note that several syllabi were fairly good. But if defining "good," "excellent," or "super" by the new expectations set as criteria for faculty to achieve in the program, then all syllabi needed some changes.

All the professors improved their syllabi, some more dramatically than others, but there were major improvements. However, when judging them by the established criteria, most still fell short of being judged as "excellent" or "super." They were all, however, "good." GN was used as the notation, meaning that although they were good, there was a need to add information professors judged not necessary to include (e.g. Support Services [special accommodations for students with challenges] or Course Purpose [statement showing the course's relationship to the field or real-world], and several others). It is important to note there are philosophical or preference differences among faculty members as to what is deemed important to include on a syllabus. Just because the program leader provides literature with criteria, and an example reflecting the literature, does not necessarily convince professors that they should include all recommended components on their syllabi or that they are necessary. Smile…

Finally, the professors spent so much time analyzing their courses and developing new products, they did not spend enough time formatting the syllabi. The syllabus is critical to students. And even though it may have all the information needed in it, if the formatting is not such that they can easily discern what the syllabus is telling them, then it is not very effective and can actually reduce their understanding of course expectations. There was a need for all professors participating in the program to reformat their syllabi visually (spending time on organization, blocking content, etc.), making the syllabus possible to understand and use as the guiding document to achieve the course outcomes. Some needed to add information as well.

Regardless of the remaining suggested improvements, there was significant change and improvement by all professors. This program component was successful and resulted in expected changes with significant knowledge and skill gain by all professors.
After the semester was over, the professors provided the following responses to several questions regarding the syllabus. Generally, they felt positive about the syllabus changes.

See their responses below on pages 5 and 6. The model syllabus is presented on pages 7-13. Finally, the chart on pages 14-18 reveal individual component evaluations across professors.

a. Do you think your student benefited from the changes in the syllabus?

Yes

I assume so. The grading scheme was much clearer and well-defined. Expectations were more clear.

Certainly, yes

Yes. In comparison to the past syllabus for this course, the current [new] syllabus is much more informative in terms of course outcomes, execution schedule, and grade distribution.

Very much so.

My past syllabus for this course didn't deviate that much from the current [new] syllabus. I would say that sections of learning objectives, schedule, and wording in general were rally improved. Therefore, I think students definitely benefited form those changes.

Yes

b. Do you think the new syllabus communicated your expectations to them more clearly?

Yes

Yes, definitely

Yes. There were immediately aware of the expectations, including performance assessments.

The syllabus provides the general expectations for this course. While the performance assessment rubrics also benefited a lot.

Yes, definitely

Yes. I think this is the major contribution.

Yes, especially with regards to objectives (outcomes) and timeliness.

c. **Do you feel that the guidelines provided by the syllabus benefited you in delivering the course? If the new syllabus benefited you, as well as the students, please note how:**

Yes

Yes. More rigorous time line organized the course better.

Yes. New syllabus is much more detailed and organized. I think the detailed student learning outcomes were most beneficial.

Yes, this provides me with better delivery, planning, and getting expected response from students (no more surprises!)

Not really; No real benefit to instructor.

Yes, I think the syllabus is good navigation map for the semester.

Yes, it helped keep everything on track.

d. **What were the students', if any, reactions or responses to the syllabus?**

The liked the detailed information

I got no reaction.

I don't recall any direct responses or reactions….other than it was big.

At the beginning of the course, I had a brief discussion about the syllabus. There was not many direct comments about the syllabus. However, smooth running of the course indicates that all the necessary information were available within the syllabus.

Positive, from students that used it.

I always spend the first hour during my first class to completely review the syllabus in my courses. I have received comments from students that they are not used to this type of syllabus and their sincere opinion is that they don't read the syllabus that much (and I know this is the case most of the time, reason why I state in my syllabus that is the student's responsibility to keep current with what is scheduled in the syllabus) But I think this is the change of culture we need to generate.

At first they were scared about the length. After going through the syllabus with them, they realized all of the information contained was for their benefit and they had a positive response.

B.10.a: Technology 496 - Industrial Project Management

Prof: Dr. Scarborough **Grad. Asst: _____** **Ph:** 753-0210(Dr. Scarborough)/1570(GA) **Off.Hrs:** T12-3 **Email: _______**

I. Catalog Course Description: Industrial Project Management (3). Basic concepts, principles, and skills of project management. Designed to cover a variety of types of project management. Emphasis on computer tools and project management techniques. Analysis of case studies. Culminating project required.

II. Course Purpose & Objectives: To prepare project leaders and team members to formally initiate, execute and terminate industrial projects effectively. To integrate and apply knowledge, skills, and abilities acquired or extended during students' college careers (general education and major) and work experience to research, design, build and finalize a technical project within a team and formal project environment.

III. Required Text: **<u>Project Management</u>**. Cleland & Ireland, 2006 or latest edition. **Required: Date book/Calendar for scheduling and notes; Handout packet.**

IV. Pre-requisites: Tech 265-Mfg. Processes;Tech 302- Graphic Pres.& Comm.;Tech 395-Ind. Data Processing; **Senior Status**

Expected Computer Usage: CAD, MS Office, MS Project, CNC, industrial equipment, or other, depending upon semester/ team project. **Required Laboratory Team Project:** Changes each semester; each team will engage in a complex technical project with specific technical standards to achieve, e.g. Go-kart, 3-car passenger train, hovercraft, paddle wheel boat, personal transport vehicle etc. Research, design, assembly of electrical/mechanical systems, testing, modifications/finalization with formal documentation, formal team products and team requirements. See requirements section, handouts, and rubrics.

V. Course Requirements:

Individual Course Requirements:	**Points:**	**Team Course Requirements:**	**Points:**	**Grading:**
Text Project (broken into sections/due dates)	7	Team Operations Manual	5	Benchmark
Project Research	5	Community Leadership Service	3	A=98-100
Project Design	5	Project & Articles		
Literature/Internet Research Tables A & B	7	Team Project Plan	5	A=93-97
(Projs/Tms/Lead/Int'l/MCTms/MCLd)		Team Project & Assessment	7	B=92-85
Career Project	5	(Final Exam)		C= 84-77
Individual Case Study	5	*Peer Assessment Process	5	D=76-70
Paper	7	& Team Success Assessment		F=69-below
Midterm: Individual Project Plan	7	*Team Member Participation		
Software Workshop/Test	5	(Ind. Pts. 3/5)		
*Team Participation Awarded by Team	3	Team Presentation & Success	5	
Project Feedback Logs	1	(Final Exam)		
Individual Portfolio & Assessment Process	3	Team Project Portfolio & Website	5	
(Final Exam)				
Professor's Overall Assessment		Final Exam II: TBD		
Ind.Presentation within Team Presentation.	5	(if needed to confirm competencies)		
Total Individual Points Possible	**65**	**Total Team Points Possible**	**35**	
Professor's Privilege	See Note #2			

VI. Student Learning Outcomes

Student Learning Outcomes	Embedded NIU General Ed Goals	Embedded NAIT/ABET Learning Standards	Assessments/Rubrics
1A/B. Identify and describe major problems, issues, concerns, and solutions (PICS) that relate to (a) projects, (b) project management, (c) project teams, and (d) project leaders, also for (e) Int'l projects and (f) multicultural (MC) teams. **2. Identify and describe best practices for managing projects and leading teams; include Int'l teams and MC teams.**	**a.i.** communicate clearly in English, demonstrating ability to comprehend, analyze and interrogate critically; **ii.** communicate in a manner that unites theory, criticism, practice in speaking & listening; **a.iv.** Aware of and able to use various resources, including modern technology	**g.**demonstrate an ability to communicate effectively in writing**;** **h.** demonstrate an ability to communicate effectively orally; **m.** demonstrate an ability to ….utilize computer applications effectively**;** **k.** demonstrates a respect for diversity and knowledge of contemporary professional, societal and global issues.	Text Project or Text Test Research- Literature/Internet; Case study; Group analysis process Formal paper; group analysis 1-5 minute learning papers; Individual portfolios; Team Project portfolio/website; Individual/team presentations Team participation & Peer Assessment Team Operating Manual Individual and Team Project
3a. Demonstrate effective project management of a technical project using appropriate PM techniques, tools, and processes: **a. planning,** **b. initiation,** **c. execution,** **d. termination** **e. evaluation** **f. problem solving** **g. leadership** **h. financial management** **i. procurement management** **j. scheduling** **k. MACE process and procedures** **3b. Design, develop, and deliver:** **e. executive team presentation** **f. team portfolio** **g. team website** **4. To integrate mathematics, the sciences, English, management, technical, technological systems knowledge and skills to accomplish individual and team project objectives:** **(a) Design, (b) Build a vehicle to technical specification that will operate; (c) Solve technical problems encountered; (d) test and evaluate the vehicle for meeting technical specifications and standards**	**a.** cultivate habits of writing, speaking, quantitative reasoning for continued learning: **a.i.** communicate clearly in English, demonstrating ability to comprehend, analyze and interrogate critically; **ii.** communicate in a manner that unites theory, criticism, practice in speaking & listening; **a.iii.**perform basic computations, display facility with use of quantitative reasoning in forming concepts for analysis and in problem solving, and interpret mathematical models and statistical info **a.iv.** Aware of and able to use various resources, including modern technology **b.** develop an ability to use modes of inquiry across a variety of disciplines in the physical sciences, mathematics: **b.iii.** demonstrate ability to use scientific methods, theories to science phenomena; **c.** develops understanding of discipline interrelatedness, applying that knowledge to an understanding of important problems & issues.	**a.** demonstrate appropriate mastery of knowledge, techniques, skills, and modern tools of the discipline**;** **b.** demonstrate ability to apply current knowledge and adept to emerging applications of math, science, engineering and technology**;** **d.** demonstrate ability to apply creativity in the design of systems, components or processes appropriate to program objectives; **f.** demonstrate ability to identify, analyze, and solve technical problems; **g-h.** demonstrate ability to communicate effectively in writing and orally**;** **l.** demonstrate commitment to quality, timeliness, and continuous improvement; **m.** demonstrate ability to ….utilize computer applications effectively; **o.** demonstrate an ability to manage projects, industrial systems, lead personnel effect. **p.** demonstrate an ability to manage and manipulate industrial systems; **q.** demonstrate knowledge, strategies and/or techniques of how to lead personnel and teams effectively	Individual & Team project research Individual & Team project design Written individual & team plan(s); Technical project prototype product produced to technical standards and specifications using technical processes Project testing & evaluation against established standards and specifications using formal evaluation tools and procedures MS Project 2003 test and application in project planning, execution, termination, assessment and evaluation MACE-Project assessment (Plan compliance & adjustments) Individual & Team Logs Individual and Team Portfolio(s); website(s); Individual and team presentations; Industrial panel evaluation Project termination with lessons learned Project evaluation by industrial panel
5. Develop the team for project and team work by: **a. developing a team operations manual** **b. developing peer and team assessment system** **c. creating team organization & process** **d. developing team project plan** **6. Demonstrate effective team performance (hopefully MC team) while:** **a. engaged in a community service project; plan, execute, & report relevance.** **b. engaged in the initiation, planning, execution and termination of a technical project** **c. engaged in course Team & Project activities**	**d.** develops social responsibility & preparation for citizenship through service and an appreciation of cultural diversity.	**e.** demonstrate ability to function effectively on teams**;** **j.** demonstrate ability to understand profess-ional, ethical, social responsibilities**;** **k.** demonstrate respect for diversity, knowledge of contemporary professional, societal and global issues;	Team Operations Manual; Team Plan Team presentation; portfolios; website; Team peer,, team, & conflict assessments/logs; Industrial panel evaluation; Formal paper ;5 minute learning papers Team success rubric

VII. Topics, Class Schedule & Due Dates

Week/Date	Topics	Date	Topics/Lab Act.	Assignment Due Dates
1 **Course Intro**	9:30 Writing Center Requirements (Jacky) 9: 45Career Project Intro and Requirements (Norwood) 10:00 Team Selection/Scheduling 10:30 Course Intro 11:30 Legacy Group Use of Planner & The Nature of Multitasking Project Research Assignment	**Teaming Team Assess.**	Team Skills Bank Finalize Teams & Schedules Plan Team Service Project Project Research Review **Schedule Writing Center NOW!!!!**	**Due 1/20** **Writing Center Appointments** **Project Research** **Bring Planner** **Community Service Art. & Plan Due1/20 4:00pm**
2 **Text 1-4, 19**	TEXT Highlights	**Teaming** ***210 sched.**	Project Design Lab	**Writing Center Appts. Due 1/25** **Text Proj. 1-4, 19, 20 due 1/25** **Industry Case ID due 1/25** **Final Project Research due 1/27**
3 **Teaming** **Text 18 & HB**	Project Teams: hidden agendas, teamwork, effective teams & members, member roles & responsibilities – Peer Assessment **(Team Packet Required)**	**Research Design** ***210 sched.**	Project Design Lab	**Text Project 18, 21 due 2/1** **Project Design due 2/4 Friday**
4 **Teaming** **Text 20**	Project Teams: conflict resolution, decision-making, teams in trouble, empowerment, trust, recognition **(Team Packet Required)**	**Teaming**	Team Manual Lab	**Lit. Research Table due 2/8** **Career Project due 2/11**
5 **Project Planning** **Text 11,6**	Project Planning - Section I Rubric & TEXT Vision, Mission, Intro, Purpose, Scope, Objectives, Deliverables, Charter, Org. Charts, Stakeholder Analysis, Com Interface, Project Review, Change Plan **[Paper due]**	**Teaming**	Research, Case, Paper, Career Validation Activity – Group Process Team Manual Lab	**Industry Case due 2/15** **Text Proj. 6, 8, 11, 16 due 2/15** **Team Manual due 2/14**
6 **Project Planning** **Text 13,**	Project Planning - Section II Rubric & TEXT Business & Proj. Success Factors, SWOT Analysis, Project Constraints, Risk Analysis, Contingency Plans & Trade Offs, Statement of Work, Goals, Work Break-down Structure	**Project Planning** ***210 sched.**	Project Planning – Section II Lab	**Community Leadership Project and Articles due 2/25 Friday** **Paper due 2/21**
7 **Project Planning**	Section II Rubric & TEXT (Continued) Life Cycle, Productivity Plan, Quality Standards & Metrics, Project Monitoring, Assessment, Control and Evaluation, Linear Charts, Resource Plan/Budget MS Project - PM Software	**Software Workshop** ***210 sched.**	MS Project-PM Software	**Text Proj. 5,9, 12, 13, 14, 15 due 3/1**
8 **Project Planning**	Section III Rubric & TEXT Environmental/Safety Plan, Security Plan, Documentation/Configuration Mgmt. Plan, Project Divestment & Termination Plan	**Software Workshop** ***210 sched.**	MS Project-PM software	**Individual Plans due 3/11** **Software Test due by 3/9**
	BREAK	**3/17**	**BREAK**	
9	Project Development & Teamwork	**3/24**	Project Development & Teamwork **[Logs]**	**Individual Portfolios due 3/22** **Team Plans due 3/25**
10	Project Development & Teamwork	**3/31**	Project Development & Teamwork **[Logs]**	**Individual Portfolios due**
11	Project Development & Teamwork	**4/7**	Project Development & Teamwork**[Logs]**	
12	Project Development & Teamwork	**4/14**	Project Development & Teamwork**[Logs]**	
13	Project Development & Teamwork	**4/21**	Project Development & Teamwork **[Logs]**	
14	Project Development & Teamwork	**4/28**	Project Testing and Initial Assessment	**Proj. Test./Assess due 4/28-29**
15	**[Final Project Assessment & Grade]** [Peer Assessments Executed & Due] [Team Member Participation Determined]	**5/5**	**[Team Presentations 8:30am-12:30]** **[Team Portfolio/Website/Success due]**	**Team ProjectAssessment due 5/3** **Team Pres./Port./Web. Due 5/5**
16 May_____ **Finals Week**		**5/12**	**Final Exam: TBD** **If needed to confirm competencies**	

VIII. Course Requirements Explanation -- Individual Requirements:

Technical Research and Design

Project Research: Research project assigned. More information about this research will be provided in class. However, it will entail an Internet/Literature search, possibly interviewing technical experts, local or suburban vendors or manufacturers, or other professors, and/or researching specific technicalities. It will also include research of all properties of materials, mathematics, and scientific principles, theories involved in the technical aspects of the project. Use research information to design the project. ***See Rubric. Individual and Group Process.***

Project Design: Students will design and prepare visuals and working drawings, schematics, etc. for the project using prior design and computer aided drafting or mechanical drawing knowledge and skills. ***See Rubric. Individual and group process.***

Real World Validation – Culminating Paper

Literature/Internet Research A: Search the literature (Internet) on project management, project teams, and project leadership; identify 45 quality sources, 15 each about **(a)**industrial projects**,(b)** project teams, and **(c)**project leadership. Develop a literature/source review **Table** summarizing what the literature/sources revealed. Topics of focus should be the**(1.)**problems, issues, concerns, **(PICs)** difficulties that arise on projects or for the teams and leaders and **(2.)**success strategies that have worked for projects, project teams or leaders in resolving the problems/issues. There must be 45 sources; these must be from major recognized journals or books on the topics. You may, however, include up to five non-traditional sources, e.g. Internet sources from industrial groups, project teams, etc. Sources must show depth in content; short "briefs" are not acceptable. **Copy** all sources if not books on **diskette** or **CD** rather than hardcopies. ***See Table Format and Rubric.   Group Process-Be prepared to discuss; thus, if no hardcopies available for reference, you need to know the material well.*** ****Create tables that are categorized, numbered and reveal in-depth information with solutions. May use for your paper.**

Literature A + B = Total Table (See Rubric)

Literature/Internet Research B: Also, research **(a)**international projects, **(b)**multicultural teams, and **(c)**international project leadership with a multicultural team; identify 15 (5 for each topic) Internet and/or literature sources that discuss **(1.)**problems, issues and **(2.)** best practices, benefits, successes of multicultural/international projects, teams, and project or team leadership. Summarize the information learned by organizing it into a T**able** identifying the source author, title, main points on problems, issues, and benefits and your comments. ***See Rubric. Individual/Group Process-Be prepared to discuss; thus, your if no hardcopies available for your reference, you need to know the material well.*** ****Create tables that are categorized, numbered and reveal in-depth information with solutions. May use for paper.**

Industrial Case Study: Identify a company that will allow you to visit and interview an industrial project team. Interview a **project leader or manager** and **at least three project team members** *or 2 project leaders and 2 project team members.* **(1.)**Ask them to identify all problems, issues, concerns, **(PICs)** or difficulties encountered on the project, about the project, team., and project leadership. Have them explain in detail; **(2.)**then, also ask them what strategies are successful for projects, teams, and project leaders. Create a table of questions and responses and present what was learned as "real-time" research.   ***See Rubric and Format. Individual and Group Process.*** **Incorporate the results into your paper.**

Formal Paper: Meet with WC tutor to organize paper. Develop a paper about projects, teams and project leadership; develop the issues and solutions in greater depth; draw conclusions and describe effective project management, effective project teams, and effective project leadership. What strategies, techniques, processes should be used to have a more successful project, team, or leader/leadership process? End with very specific recommendations to guide your project team on each of the 3 primary topics. Then include a section on how international projects and multi-cultural teams differ, what additional concerns, problems, and issues occur when operating internationally with diverse cultures. Make recommendations for successful international projects and on how to be a more effective leader of multicultural teams. Sixty (60) sources required (45 + 15). These 60 sources **<u>may or may not</u>** be the same ones that you identified for the literature review table.   ****Incorporate the results of industrial case study** into your paper as well. Use the **APA** writing style manual. Identify all sources **in the paper's text** and in References Cited using the APA style format. Writing skills are seriously graded on this product. ***See Writing Rubric, Paper Outline & Rubric. Individual and Group Process.***

Project Planning - Midterm Exam

MS Project Software Workshops/Test: Participate in the software workshop(s).   Complete **Test.**   MS Project documents required in PLANs.
Midterm - Individual Project Plan: Use the outline & rubric provided as a guide, develop a detailed project plan. The plan will not be accepted unless every category is complete. Reference the text, other sources in the library or through the Internet, or sources listed on the course syllabus. All members of a team must have their plan in and graded before they will be approved to work on the "team" plan. This is another product where writing will be graded seriously. This is technical writing which is different than the narrative or prose approach used in the above assignments. ***See Plan Outline/Rubric.I/GP***

Employment

Career Project: a) Interview Mr. Norwood, the CEET Career Planning & Placement specialist, on the assigned topic; engage in group process. Document findings as assigned (TBD); **b)**Research jobs/positions/career in project management; Bring in copies of 10 position announcements which review expectations, required knowledge, skills, background for those seeking to become project managers, team leaders, or project team members; **c)** Design and develop a resume to use to seek such a position, but also make it applicable for other industrial technology, management, engineering, etc. positions. Have it reviewed and approved by Mr. Norwood for inclusion into personal 496 portfolio. Mr. Norwood will grade this project.

Individual Portfolio: This portfolio has a somewhat different focus. Although it may contain everything in the team portfolio for job-seeking purposes, it must also include all individual work, including Writing Center Reviews and multiple iterations of particular products. Use Course Requirements list on Course Syllabus (above) and Team Portfolio Rubric to determine what is to be included. You will participate in assessment activities throughout the semester, including analysis and reflections about what your strengths and weaknesses are and what you **can do to improve or continue well. The portfolio must be professionally presented, e.g. typed tabs, etc. Final Reflections at end of semester/questions to answer.**

Team Requirements:

Community Service Project: Each team has to research, determine, plan and execute an 8 hour service project. Research one article per team member on the benefits of community service and leadership by local industrial personnel. Generate a brief team plan of what, who, when and where. It should include a goal, operational objectives, expected outcomes and benefit to group served. Prepare an **informal presentation** about what you learned, how you felt and your potential future in community service. ***See Rubric**. **Individual/ Group Process***

Team Process

Team Manual: The team manual includes all team operational policies and procedures, the team problem-solving process, communication strategy and procedures, decision-making process, authority linear charts, team roles and responsibilities, etc. The team is to provide evidence that it operated using the team manual as its structure, process and guiding document. ***See Outline/Rubric. Group Process.***

***Included in the Team Manual are the following critical components, plus others: See Team Manual Outline/Rubric.* Group Process.**

> **Team Skills Bank**: Each team will prepare a team skills bank that identifies all individual talent, skills, knowledge that each team member brings to the project. This bank will be used to organize the team, project, work packages and deliverables. **Group Process.**
>
> **Team/Project Charter, Logo, Company & Project Organizational Chart:** Each team will create an official charter, identify a team logo, and design an organizational chart for their company and their team/project. **Group Process.**
>
> **Team Assessment Inventory(ies):** Each team will design and develop a peer and team status inventory to use to monitor team process; they will also adapt a conflict management inventory to use to monitor the team conflict resolution process. The information gained from using these inventories will be used to build and strengthen the team and to identify and solve team issues or problems. Growth and development should be an outcome of using these instruments. Each team must produce a report of results from using these instruments and assessment process twice during the project period.

Team Project Plan: Each team must write/develop a team plan; however, the team may not begin on the team plan until all individual plans are graded and returned. The plan outline is the same as the individual plan. Each team must produce a plan for the technical project assigned and use the plan as a compliance document to monitor, assess, control and evaluate the project. ***See Outline/Rubric**. **Group Proc.***

Logs: Periodically you will be asked to complete a log about how you feel the team and project are progressing. Completed and turn in.

Individual Component of Team Presentation: Speaking, non-verbal communication, presentation skills, content, grammar/wording visuals, style, organization, use of technology, humor, etc. graded individually during team presentation. Remember that each team member must demonstrate speaking and presentation skills. Teams could acquire the full point value, but individuals will be assessed on their individual performance as well. Professional dress required. ***See Presentation Outline/Rubric.***

Team Participation Points Awarded by Team: Each team member will be allocated points for team participation. Teams will award points to team members for quality of work and participation. Points will serve to "grade" participation. Dr. Scarborough validates that the distribution is appropriate for participation observed. Full participation is expected of each team member. Tardiness or absences from team meetings, class, labs are not acceptable behaviors. You will be asked to explain to the class openly why you are late or absent and points will be deducted. ***See Rubric**. **Individual/ Group Process***

Final Exam

Team Project: Each team will be responsible for designing and developing a technical project. You will generate technical standards to achieve and the metrics to use to measure the standards achievement level. The project must "function" or "work" to be accepted for a grade. It must meet the standards at the level described in the team plan using the metrics predetermined. Every team member must have major project role and responsibilities. The team must complete the project by the deadline on the syllabus. The project is the "vehicle" providing evidence of high performance teaming and project management as well as the knowledge, skills, and abilities from academic career and work experience. ***Team derived/Professor approved- predetermined -Standards/metrics = grading Rubric. Group Process.***

Team Portfolio: The portfolio is the culminating documentation of all project and team work. It must include information on every topic listed in the outline/rubric. It should include pictures, mechanical drawings, etc. and be professionally produced in hard-copy form. An operator's and maintenance manual must be developed and included for the technical project (product). ***See Rubric. Group Process.***

Team Website: Each team is to design and produce a team web-site which will serve as an electronic portfolio. This website/ portfolio must be presented during the team presentation. The outline is the same as the hard-copy portfolio. A CD must be included in the hard copy of the team portfolio. ***See Rubric. Group Process.***

Final Team Presentation: Each team is to professionally present their project, portfolio/website and information for each category on the presentation outline. This is a formal presentation where communication skills, presentation skills, etc. will be graded. Professional dress required. An industrial panel will observe the presentations. ***Presentation CD must be in Portfolio. See Outline/Rubric.***

VIII. Cheating:
Cheating is unacceptable; refer to the NIU Judicial Code; any students cheating will be dismissed from the course immediately.

IX. Academic Misconduct: Refer to the NIU Judicial Code; Immediate and appropriate actions will occur for any students behaving inappropriately, e.g. cheating, will be dismissed from the course immediately.

X. Professor's Role: This course involves the professor and graduate assistant in a variety of roles; the professor will provide a scenario, objectives, and standards and then guide, coach, and direct most of the time, however, there will be some lectures. This course is performance based, thus, there are usually no traditional objective tests. There are subjective tests in the form of the 5-10 minute learning papers, essays and the text project to determine concept attainment. Students will construct knowledge/skills while engaged in learning & performances. Assessment will occur <u>as</u> learning occurs.

XI. Professor's Notes:
1. Unexcused absences could result in one letter grade reduction each **(7pts)**. Class/lab/ team meetings/work sessions attendance mandatory. **Tardiness unacceptable. Door may close when class begins; late admittance may not be permitted according to prof.'s prerogative.** Unexcused class/team tardies, **1 point per 30 minutes IF you are allowed in and door is open; don't count on door being open.**
2. The professor reserves the right to determine the final grade in the case of a student who does not perform on the team.
3. Unexcused late projects/assignments will result in point reduction, **2 points per day late**.
4. Dress code: no hats in lab **ever**! Professional dress **required** for final presentation.
5. Monitor language in class/lab at all times; good grammar and communication skills expected at all times; professional language expected.
6. Students are required to see the Writing Center tutor for all written assignments until approved otherwise, at least 2 visits per assignment; 3 visits required for paper. **(1)** Meet once to design paper, then meet with draft in hand **(2-3)** twice and rewrite. An appointment to plan the written assignment with no draft for review would still require 2 other visits for all other assignments.
7. Unannounced individual portfolio checks throughout course; 5 point penalties for portfolios not up to date each time.
8. No cell phone ringers in the class or lab at any time; **5 points deducted for in-class interruptions**. See professor exception approval.
9.Students can not pass class without ALL assignments turned in. Student will receive an I (incomplete) until all assignments are turned in. Penalties may occur for grades of Incomplete.

XII. Support Services Available for Students: The NIU writing center provides tutoring for writing. Students in this class are required to use that service for all written assignments; each writing assignment requires two visits/critiques and rewrites before assignment can be handed in to professor. Tutor signatures and forms are required to be turned in with written products. Math and science tutors available in College. NIU accommodations for any student with special needs. See professor individually.

XIII. References on reference in Founders Library on NIU main campus: Kerzner. Smith. <u>Project Management & Teamwork</u>. McGrawHill. Angus, Gundersen, Cultinane. <u>Planning, Performing and Control- ling Projects</u>. Prentice Hall. 2000; Dinsmore. <u>Human Factors in Project Management</u>. Dinsmore. <u>Project Management</u>. Thomsett. <u>The Little Black Book of Project Management</u>. AMACOM; Kerzner, Thamhain. <u>Project Management Operating Guidelines</u>. VNR.; Rosenau. <u>Successful Project Management</u>. VNR.; Weiss, Wysocki. <u>5-Phase Project Management</u>. Addison Wesley; Cleland, Gareis. <u>Global Project Management Handbook</u>. McGrawHill.; Miller. <u>Visual Project Planning & Scheduling</u>; Barkley, Saylor. <u>Customer Driven Project Management</u>. McGrawHill; Lewis. <u>Mastering Project Management</u>. McGrawHill; Forseberg, Mooz, Goterman. <u>Visualizing Project Management</u>. Wiley; Dinsmore. <u>Winning in Business With Enterprise Project Management</u>. AMACOM; Graham, Englund. <u>Creating an Environment for Successful Projects</u>. JoseyBass;Gray, Larson. <u>Project Management.</u> McGraw Hill. 2000.; Cleland. <u>Project Management</u>. McGrawHill; Meredith, Mantel. <u>Project Management</u>. Wiley. 2000; Lewis. <u>Team-based Project Management</u>. AMACOM; Kliem, Ludin. <u>Project Management Practitioner's Handbook</u>. AMACOM; Kerzner. <u>In Search of Excellence in Project Management</u>. ITP VNR; Ruskin, Estes. <u>What Every Engineer Should Know About Project Management.</u> Dekker; Buttrick. <u>The Project Workout</u>. FT Pitman; Rowenau. <u>Project Management for Engineers</u>. Ran Nostrand Reinhold; Cleland. <u>Field Guide to Project Management</u>. ITP VNR.

XIV. Course Requirements Check Off

Individual Contributions: **Benchmark=98-100 (This means that you set the standard for others.)**

A=93-100 points
B=92.9-85 points
C=84.9-77 points
D=76.9-70 points
F=Below 70 points

_____ (7) Text Project

_____ (5) Project Research

_____ (5) Project Design

_____ (7) Literature/Internet Research Tables A & B

_____ (5) Career Project

_____ (5) Industrial Case Study

_____ (7) Paper

_____ (7) Midterm: Individual Project Plan

_____ (5) Software Workshop/Test

_____ (1) Project Feedback Logs

_____ (5) Professor's Overall Assessment

_____ **(65) Total Individual Points Possible**

Note: To keep track of your progress, add the possible points of work to date; then figure the percentage, e.g. Text (7)+P.Research(5)+P.Design(5)=17 .93 x 17 = 15.81 = lowest possible score or point value to maintain an A(lowest A).

IF your goal is to be a **Benchmark Student,** where your work best exemplifies the(confirmed by Professor) course's highest standards …where you set the standard, then you must maintain no lower than 98% or ultimately 98 points for the course.

Team Contributions:

_____ (5) Team Manual

_____ (3) Community/Leadership Service Project/Articles

_____ (5) Team Project Plan

_____ (7) Team Project & Assessment (Final Exam)

_____ (5) *Peer Assessment Process/Team Success

_____ (5) *Team Member Participation

_____ (5) Team Presentation & Success (Final Exam)
*Individual Presentation (in Team Final Presentation)

_____ (5) Team Project Portfolio & Website

_____ **(35) Total Team Points Possible**

IF a team's goal is to be a **Benchmark** Team**,** where the team best exemplifies the course's highest standards for teams… where the team sets the standard for other teams, then **every team Member** in that team must maintain **98**% or ultimately 98 points each for the course.

Table B.10.1: Syllabi – Fall 2005 → Fall 2006 (Syllabus Rubric, Scarborough, 2006)

	Syllabus Components	RM		RR		AA		BT		IM		BC		AG	
		05	06	05	06	05	06	05	06	05	06	05	06	05	06
	Faculty/GA Contact Info Crse.-Off.Hrs.	√	+	√	+	√	+	√	+	√	+	√	+	√	+
I.	a. Course Description	√	+	√	+	√	+	√	+	√	+	√	+	√	+
	b. notes lab	▯	?	√	?	√	?	▯	?	▯	?	▯	?	▯	?
II.	Course Purpose	▯	+	▯	+	▯	+	▯	+	▯	▯	▯	▯	▯	▯
III.	Requirements: Text, Plan book, handout put, other, etc.	√	+	√	+	√	+	√	+		+	√	+	√	+
IV.	a. Pre-requisites	√	+	√	+	√	+	√	+	√ By topic√	+ By topic	√	▯	√	+
	b. Computer Technology Use	√	+	▯	▯	√	+	▯	+	▯	▯	√	+	▯	▯ Some-what Inherent

	Syllabus Components	RM		RR		AA		BT		IM		BC		AG	
V.	**a. St. Learning Outcomes-Objectives** ***Objs. 05** **Most called Outcomes, Objs.**	√ ABET Labeled course-Program outcomes + Rel. Rating	+ ABET+Rel. Rat. Dept. Ed. Objs.	√ ABET Labeled course-Program outcomes + Rel. Rating	+ ABET	√ ABET/NAIT LO	+ ABET/ NAIT	√ ABET/NAIT LO St. LO M.Verbs?	+ ABET /NAIT	√ ABET Mixed style	+ ABET	√ ABET	+ ABET	√ Style confusing	+ ABET
	b. Course Objectives (NR-Not requested)	√ Ex. Verbs	NA	√ M.Verbs ?	+ In Purpose	√ M. Verbs?	NA	NR	NA	P	NA	√ M. Verbs ?	NA	√ M. Verbs ?	NA
	b. Embedded Gen Ed Goals	▯	▯	▯	+	▯	+	▯	+	▯	+ ABET	▯	▯	▯	+
	c. Embedded ABET/NAIT Standards	√	+	√	+	√	+	√	+	√	+ ABET	√	+	√	+
	d. Assessment Connections	▯	▯	▯	+	▯	P should be itemized	▯	+	P +few	+	▯	▯	▯	+
VI.	**Course Outline Schedule Assignments Due Dates**	√	P No Assign. No Due Dates	√ No Schedule	+	√ No schedule	+	P Readings	+	P Topics No schedule	+	P Topics	+	P	+

	Syllabus Components	RM		RR		AA		BT		IM		BC		AG	
VII.	**a. Course Requirements-assessments/ score values** **b. Individual vs. Team Req.**	▯ **P Read-ings; soft-ware** **P**	+ ▯	▯ ▯	+ ▯	▯ ▯	+ ▯	▯ **P Projects, Homework** ▯	+	▯ ▯	+	▯ ▯	+ +	▯ ▯	▯ ▯
VIII.	**Policies (e.g., cheating, lap-tops, conduct, book bags, calculators, due dates, etc.)**	√	+	▯	+	√ **Attendance Homework Misconduct**	+	▯		▯	+	√	+	▯	+
IX.	**Professor's Role (Responsibilities)**	▯	▯	▯	+	▯	+	▯	▯	▯	▯	▯	+ **+Student's Role**	▯	▯
X.	**Professor's Notes**	√	▯	▯	+	▯	+	▯	▯	▯	▯	▯	+	▯	+

	Syllabus Components	RM		RR		AA		BT		IM		BC		AG	
XI.	Support Services	▯	▯	▯	▯	P Special assistance	▯	▯	▯	▯	▯	▯	+	▯	▯
XII.	Course References Resources	√ Library	+	▯	▯	√	▯	▯	▯	√	+	√	+	▯	▯
XIII.	Course Requirements Explanation	▯	Lists only	▯	Lists only	▯	Lists only	▯	Lists-Full PAs	▯	Lists only	▯	Lists Brief Descrip-tions	▯	Lists only
XIV.	a. Course Requirements Check Off/ Points for Self Tracking	▯	+ % Categories	▯	+	▯	+	▯	+	▯	▯	▯	+	▯	+
	b. Grading Values Explanation	√ % Pt. values	+ % Points	√ %	+ % Benchmarks	√ %	+ Points	√ %	+ Points	▯	+ %	√ %	+ % Points	√ %	+ Points
OTHER		Fin. Rpt. For.	Research Explana-tion	El.							Expecta-tions				Parti-cipa-tion
Q Level		N	G-N	N	E-S	N	G-N	N	G-N	N	G-N	N	G-N	N	G-N

Legend: √ = Done rather well P = Partial NA-Not applicable

Quality Level: S =SuperSyllabus E = Excellent according to Benchmark & Literature G = good/adequate N = needs important improvements

MODELS AND STYLES OF TEACHING SUMMARY
(See Tables in Portfolio Section B.5.b; also, B.11.a, b, c, and Section A.5)
Jule Dee Scarborough, Ph.D.

Professors engaged in the consideration of teaching models in several program components throughout the program. Initially, in analyzing the 2005 courses, they considered what teaching models were being used during those courses. Later, they studied them more deeply to determine or select a few to use in their redeveloped courses for the 2006 experimental research semester, known as the 2006 courses. The teaching model goal for each professor was to broaden his/her repertoire of teaching models and select some, other than lecture, to use in newly developed 2006 courses. A common model chosen by all the professors was cooperative learning; others were selected as well and differed across professors.

Course Analysis
The initial consideration of teaching models was during the Course Analysis program component. Professors analyzed their 2005 courses to identify their current use of the 24 teaching models presented by Joyce, Weil, and Calhoun (2004). (See the GAPS Analysis results, Portfolio Section B.5.3) Generally, they all realized that their reliance on lectures, where students are passive (Dale's Cone, 1964) and the professors "impart" course content, was far too frequent and was their primary teaching model. Once they realized the number of models available from which to choose, they were more than willing to expand their repertoire of teaching models. The GAPS Analysis Summary reveals that the professors are willing to consider using many of the other models presented by Joyce et al. (2004). Once they realized their model options, the professors were positive about choosing some new ones to try during the experimental research semester in 2006.

Consideration of teaching models was triangulated with teaching styles and student learning styles. During this analysis, professors also studied their 2005 courses to determine which teaching styles they used in the courses. During this initial exposure, they were introduced to Mosston and Ashworth's (1990) styles and found that the primary style used was abstract conceptualization. They realized, once again, that there was an opportunity to increase their repertoire of teaching styles and were willing to make some new choices to implement in the 2006 courses. Teaching models and styles go in tandem with each other, so their willingness to expand their use of models for both was reinforcing.

Finally, the third aspect that completes the triangle, related to the relationship between teaching and learning, was the learning styles they made possible for students to experience as a result of the teaching models and styles used. To learn first hand about learning styles, they analyzed their own learning style using the Kolb Inventory. We also discussed how the faculty development program had presented opportunities for them to observe or experience a wide range of teaching models and styles while learning, as we modeled what we were asking them to use in their own classrooms. The modeling also provided different learning style opportunities for them as they progressed through the faculty development program. After they studied their own individual Kolb (1984)

learning style profile and engaged in a round table of discussion, they better understood how to broaden the learning style experiences for their students. Three professors decided to formally use learning style inventories with their students. The results are presented in the GAPS Analysis Summary in Portfolio Section B.5.3, and it is copied into this section for reader convenience. The professors realized that the primary learning style possible as a result of the teaching models and styles used in their 2005 course was abstract conceptualization (Kolb, 1984). Thus, the realized the need to broaden student learning style opportunities in the 2006 courses; They were very willing to structure the course and teaching models and styles to increase learning style opportunities in the 2006 course.

2006 Course Development

Once they completed the new student learning outcomes, the new tests and performance assessments, and the new syllabus draft, each professor then engaged in a deeper study of the teaching models by using the following worksheet with the Joyce et al. (2004) book to more closely examine each model. They were also provided with more perspectives on styles, Grasha (1996), further realizing that they relied on the “expert” style as presented by Grasha. They were also introduced to another perspective on learning styles by Felder (1988). Two professors chose to use the Kolb Inventory, and one chose the Felder Inventory. This study, or deeper examination, of the teaching models was followed by questions and discussion. Once they felt comfortable, they individually made instructional decisions about which teaching models and styles they wanted to use in the 2006 course that would result in students experiencing the whole range of learning styles. The professors hoped to stimulate opportunities for students to engage in a broader range of learning styles, so each student would have the opportunity to learn in his/her learning style “comfort zone,” while also broadening his/her capabilities across learning styles.

Data is presented in several ways. The Gaps Analysis data presents both the 2005 responses resulting from the course analyses as well as the data on their responses about what models, styles, and learning styles actually occurred throughout the 2006 experimental course.

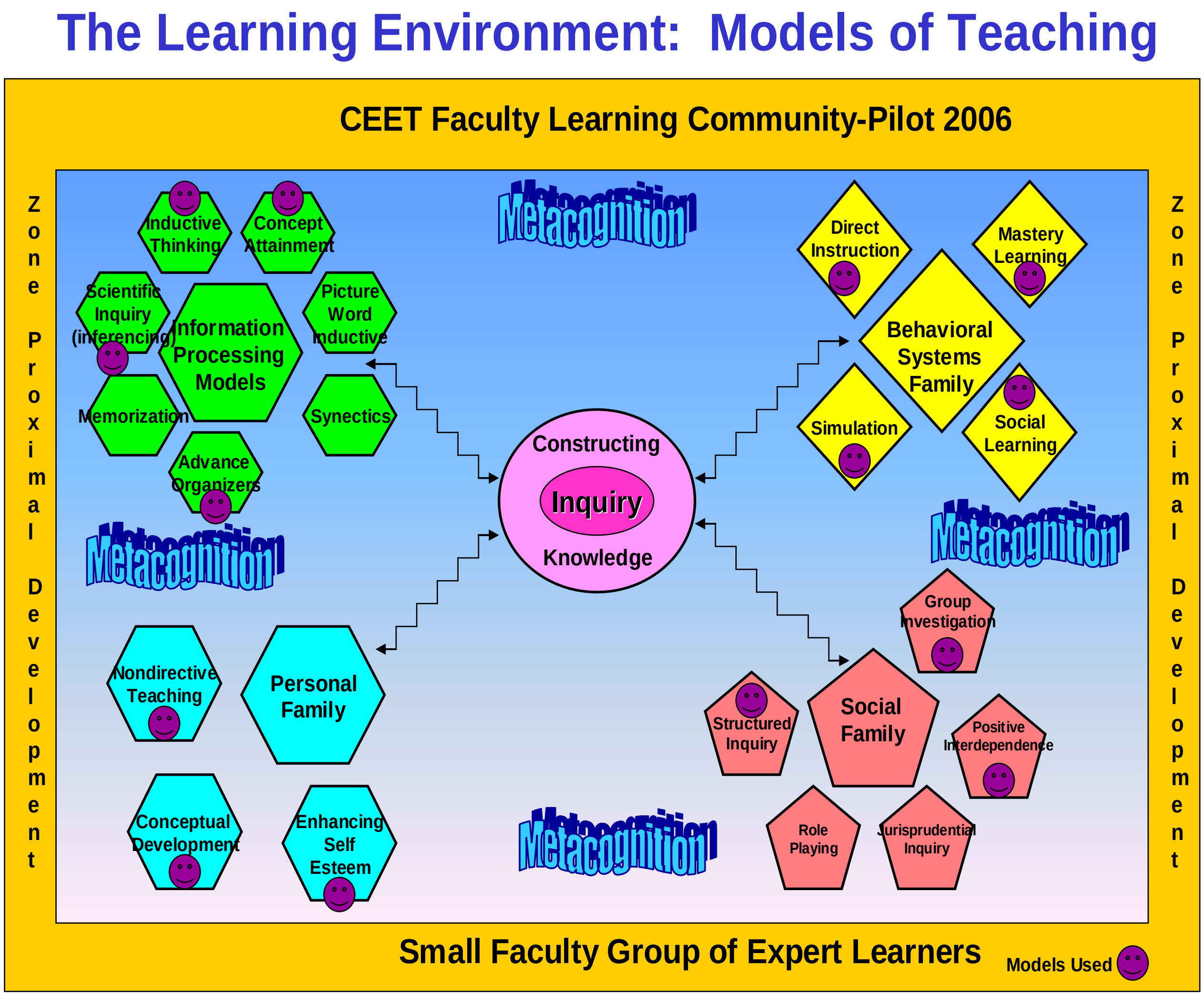
The process was a simple one. They reviewed the worksheets from the 2005 course analysis indicating which models, styles, and learning styles they felt occurred. In addition to the reconsiderations of the 2005 worksheets, they also responded to a list of models, styles, and learning styles with brief descriptions and indicated which ones they felt were used or experienced in the 2006 course. And, finally, they reviewed the study forms they completed when more deeply studying the models and noted which ones they felt were used. Therefore, after teaching the 2006 courses, they came back to informally analyze what they felt occurred using a variety of formats. The picture became clear that they did try many new models and styles that probably stimulated students to engage across the learning styles. In one semester, we felt they accomplished a great deal. Are there many more models and other styles they can introduce to broaden student learning style experiences? Yes, definitely, and they will also become more expert in using the models and styles they tried out for the first time or more formally than before. This is just our beginning and initial changes were significant.

Generally, all professors made an effort to build their 2006 courses incorporating constructivism as the process to achieve the higher levels on Bloom's Cognitive Process Dimension with students. Their goals were to increasingly engage students in strengthening their metacognitive skills. They reconsidered their course content structure and, as a result of that process, addressed scaffolding such that the learning process better engaged students in building their knowledge and skills while stretching them to achieve new knowledge and skill outcomes. This process began to build a climate or lead them into the development of a "zone of proximal development" for their students. Remember the 2006 semester was the first attempt to begin building a learning environment different from the 2005 course. The professors had just been introduced to many of these concepts, but with awareness and some understanding, they began to formally engage in changing the teaching and learning environments and climate for learning in their classrooms. Ultimately, for them to achieve deeper understanding and to document formal changes, they will have to engage in semesters of that change, gradually making more and more changes – each time with deeper understanding of the theories, concepts, and models. This initiative was the pilot to begin that process.

The research semester was successful in implementing new learning models and styles and seemingly to provide a wider range of student learning style opportunities, appropriate for their level of awareness, knowledge, skills, and experience. The new teaching models and styles strengthened the possibility of engaging students more actively (Dale, 1969) and at higher cognitive process levels (Bloom, 1956). The professors gained significantly in the knowledge about teaching models and styles; they gained significant experience in trying new ones in the 2006 semester. Although there is much more to learn, experience, research, and consider, each professor in this initiative made significant change using what they learned. The charts below present data that indicate what they have learned and what they still need to learn about and be willing to try.

See the Summary Tables B.10 a and b for both an individual and collective picture regarding professor responses to considering the Joyce et al. models.

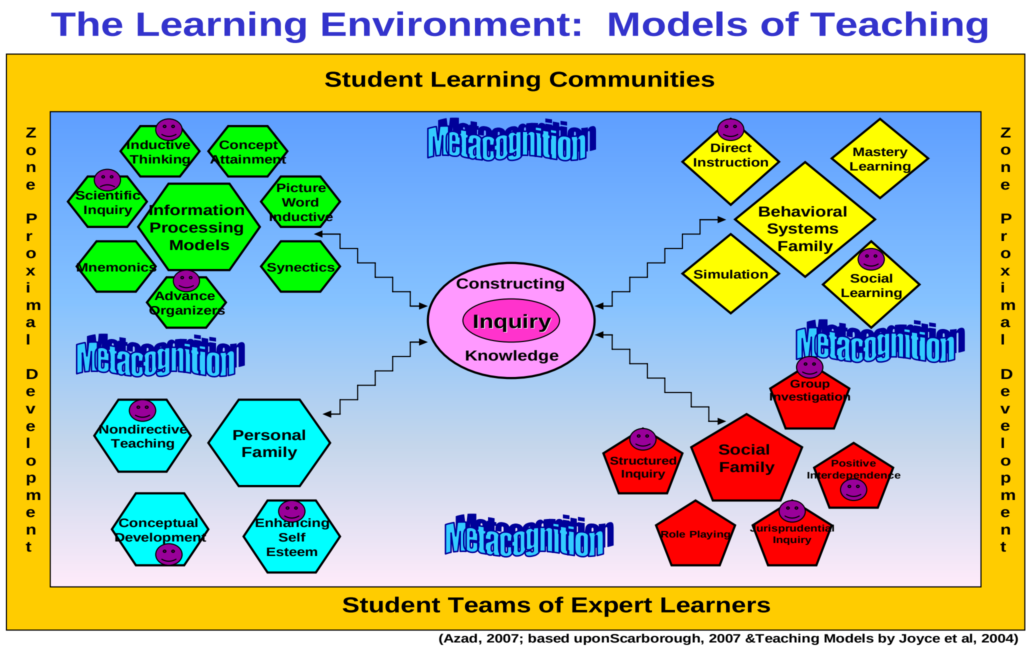
The following Map was used to organize and report teaching models (Joyce et al, 2004). Figures B.11.1-8



Scarborough, 2006 (Teaching Models by Joyce et al, 2004)

Each professor created a Models of Teaching Map for their 2006 experimental courses. See models below.

CEET Faculty Members Teaching Model Maps 2006 Courses

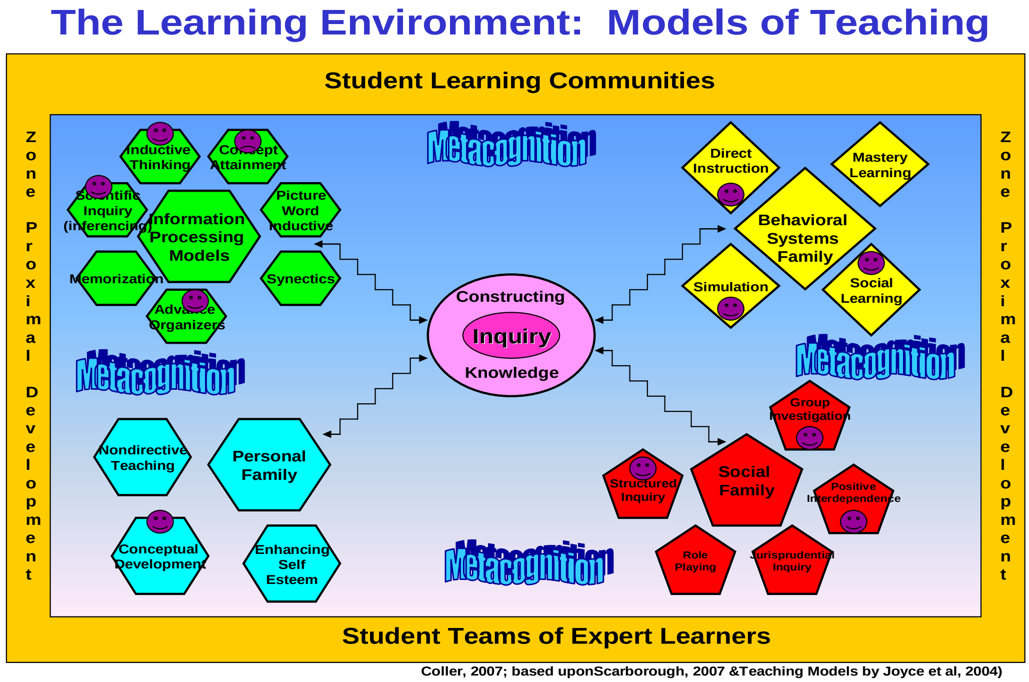


Graphical Display Teaching Models

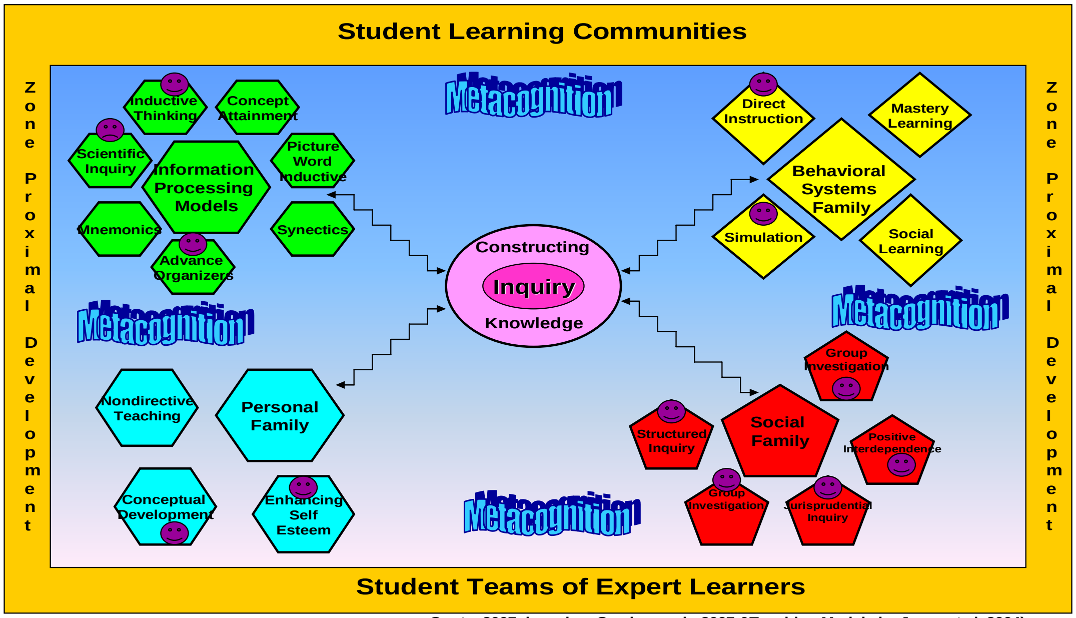
Note:

The smiley face attached to a model indicates using of that model.

- If the smiley face appears at the top of the model indicates usage of that model as stated earlier.
- If the smiley face appears at the bottom of the model indicates partial usage or success.



The Learning Environment: Models of Teaching

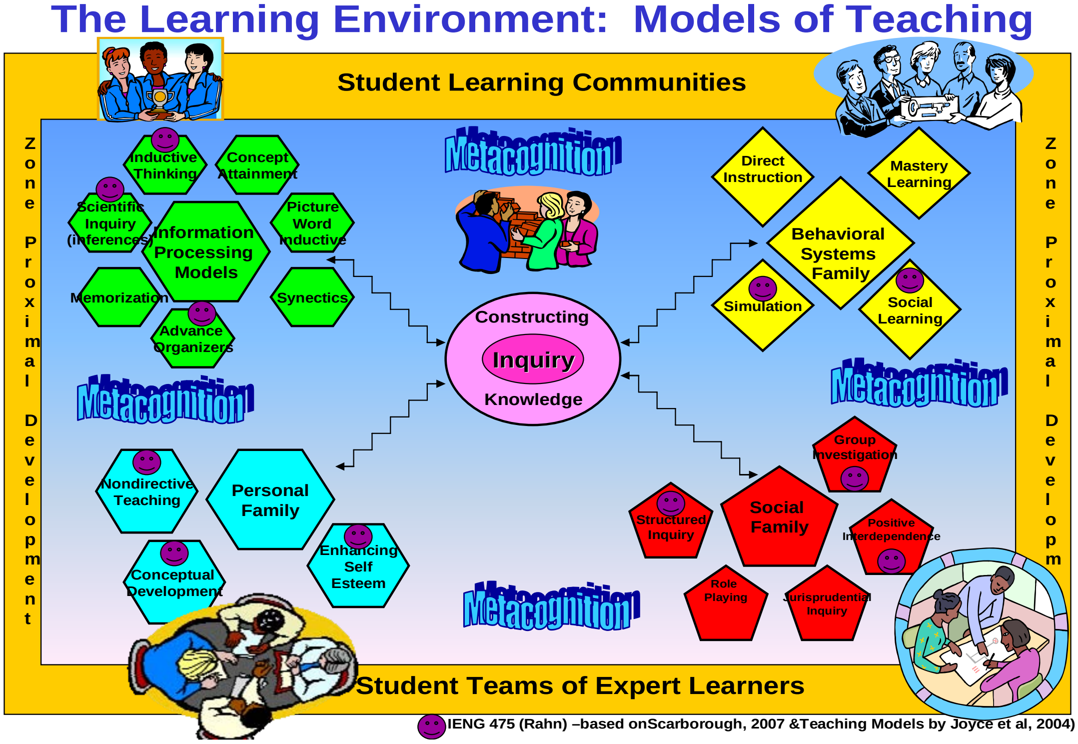


Gupta, 2007; based on Scarborough, 2007 &Teaching Models by Joyce et al, 2004)

Graphical display teaching models

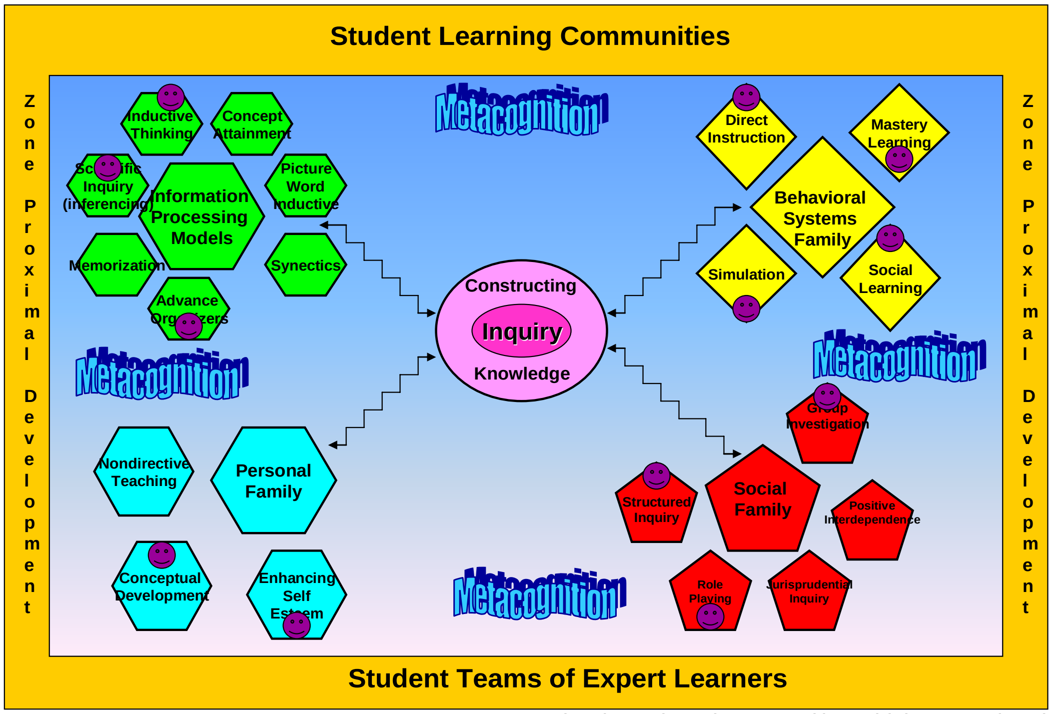
Note:
The smiley face attached to a model indicates using of that model.
If the smiley face appears at the top of the model indicates usage of that model as stated earlier.
If the smiley face appears at the bottom of the model indicates partial usage or success. May need further tweaking.

The Learning Environment: Models of Teaching



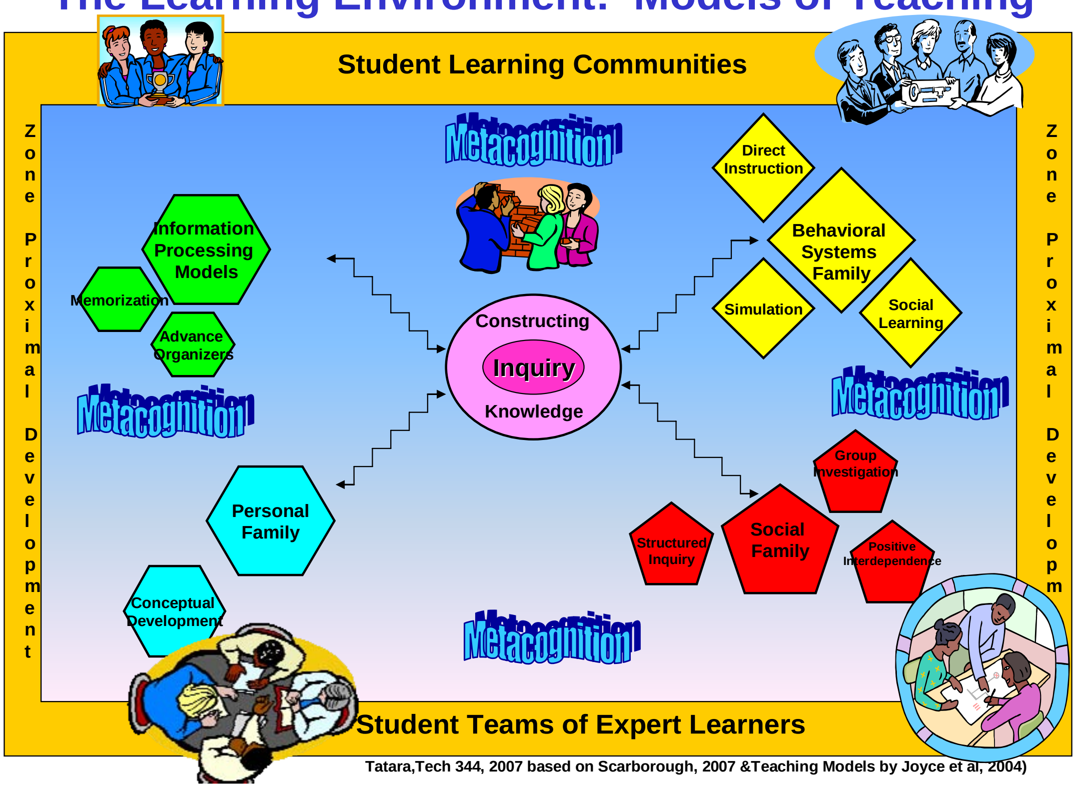
IENG 475 (Rahn) –based onScarborough, 2007 &Teaching Models by Joyce et al, 2004)

The Learning Environment: Models of Teaching



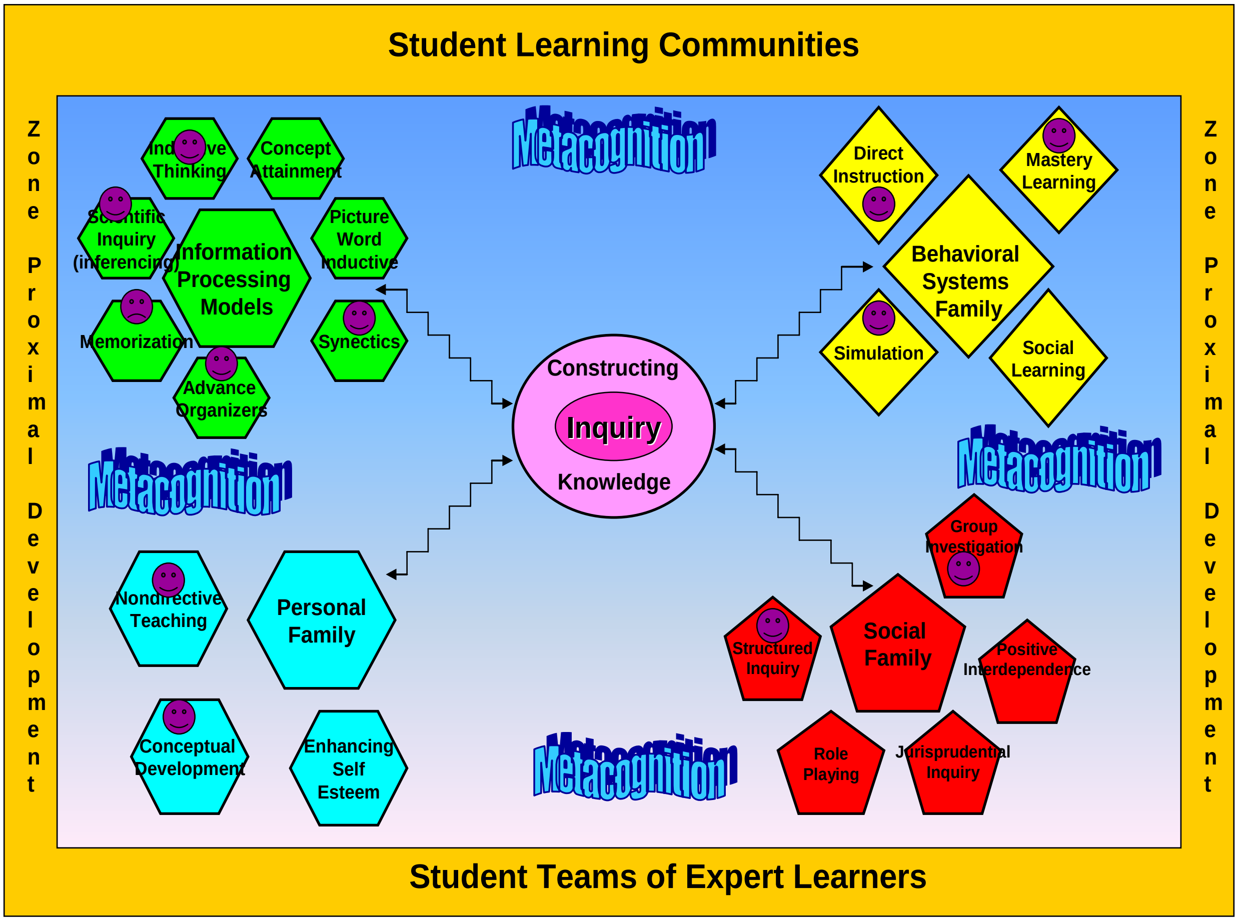
Moraga, 2007 based onScarborough, 2007 &Teaching Models by Joyce et al, 2004)

The Learning Environment: Models of Teaching



Tatara,Tech 344, 2007 based on Scarborough, 2007 &Teaching Models by Joyce et al, 2004)

The Learning Environment: Models of Teaching



Motaleb, 2007; based on Scarborough, 2007 &Teaching Models by Joyce et al, 2004)

Group Implementation Summary of Individual Responses
Jule Dee Scarborough, Ph.D.

Table B.11.a.1: Foundation: Concepts that Apply to Learning

Concepts – Chapter 1, p.3	**Description: Professors defined each concept/model.**	**Meaning for Me and my Practice**	**Changes I will make based upon my understanding of this concept?**	**Where will these changes "show up" in the teaching and learning experiences throughout the semester?**	**2006 Confirmations** **Y=yes, will continue** **P=partial, tried; will try again** **C=did not try, but committed** **N=did not, will not later**
Constructivism, p.12		6 professors expressed understanding of the concept as philosophy, model or strategy. 5 itemized ways to implement constructivism. There was 1 NR and 1 need to improve	6/7 professors discussed changes they could make. One professor did not respond and had admitted in previous column-needed to improve.	Each professor identified where or how they would implement changes in the course to engage student in contructivism	5 Yes 2 NR
Metacognition, p. 14		Professors discussed various ways of tapping into metacognition more often (e.g. understand process of learning; monitoring own learning; the role of good assessment, etc.)	5 identified the changes they could make; 1 NR.	5/7 professors itemized ways to increase metacognitive engagement by students, some very specific examples; 2 NR	4 Yes 1 Partial 2 NR
Scaffolding, p.14		Professors expressed understanding of the concept; some provided examples of how to implement or how they already implement scaffolding.	3 NR; 1 indicated scaffolding already in place; 3 itemized how they would implement scaffolding.	3 NR; 1 continually; 2 provided specific examples.	5 Yes 2 NR
Zone of Proximal Development, p.16 **(optimal mismatches with tasks and students)**		Professors expressed the understanding of importance of this concept and indicated that they needed to make this happen.	3 NR; 3 described the changes they would make; 1 indicated already in place.	5 identified specific examples; 1 yes; 1 not possible to interpret.	3 Yes 2 Partial 2 NR
Roles of Expert Performance, p.2		1 NR; 5 professors expressed general understanding of how to accomplish in class; 1 yes	2 NR; 1 Not sure; 4 descriptions of how this can happen.	3 NR; 1 Not sure; 4 specific examples of how to accomplish	2 NR; 1 No; 4 Yes

Table B.11.a.2: I. Models of Teaching – Information Processing Models

Models	**Description: Professors defined each concept/model.**	**Strengths**	**Weaknesses**	**How I can use this model-describe**	**2006 Confirmations** **Y=yes, will continue** **P=partial, tried; will try again** **C=did not try, but committed** **N=did not, will not later**
Inductive thinking, Ch.3, p.41 (classification-oriented)		Professors expressed understanding of model.	3 NR; 4 identified specific weaknesses.	6/7 identified specific ways to implement model	4 Yes 2 Partial 1 NR
Concept Attainment, Ch.4, p.59 (includes concept formation)		3NR/? 4 professors expressed understanding.	1 NR; 1didn't see any use for model; 5 specified weaknesses	4 expressed model as not useful; 3 NR	6 No 1 NR
The Picture-Word Inductive Model Ch.5, p.77		Although the professors appear to understand the model; they did not find it acceptable for use.	Same	Same	1 will use to introduce symbols 4 No 1 Not applicable; 1 NR
Scientific Inquiry, Ch.6, p.101 Inquiry Training		3NR; 4 expressed understanding and results related. *Disappointing to have 3 NRs on such a critical model for engineering/technology	2 NR; 5 identified specific weaknesses	7 identified specific uses	4 Yes 2 Partial, still committed 1 NR
Mnemonics, Ch.7, p.131 (memory assists)		5 professors expressed understanding by providing examples of how to use-strengths. 2 NR	5 itemized weakness 2 NR	2 specified how they would use this model 5 felt not useful	1 Partial 5 No 1 NR
Synectics, Ch.8, p.155 (includes metaphoric activity)		4 acknowledge strengths well 2 NR; 1?	4 specified weaknesses 2 NR 1?	1 felt the model has potential 2 will not use; 3 NR; 1?	2 Partial; committed to trying 4 No; 1 NR
Advance Organizers, Ch.9, p.187		2 NR 5 felt positive about using AO, specifying how-strengths	3 NR 4 identified weaknesses	2 NR 5 confirmed model as applicable; gave example	4 Yes 1 Committed to trying 1 No; 1 NR

Table B.11.a.3: II. Models of Teaching – Social Models

Model	Description: Professors defined each concept/model.	Strengths	Weaknesses	How I can use this model -describe	2006 Confirmations Y=yes, will continue P=partial, tried; will try again C=did not try, but committed N=did not, will not later
Partners in Learning, Ch.10, p.205					
Positive Interdependence, p.211		2 NR 5 specified strengths	1 NR 6 specified weaknesses	1 NR 6 specified examples	5 Yes 2 Partial
Structured Inquiry, p.221		1 NR 6 professors specified strengths	5 NR 2 identified weaknesses	5 identified where or how they would use this model 2NR	3 Yes 1 Committed to trying 2 No; 1 NR
Group Investigation p.213,14-227		2 NR 5 specified how to use - strengths	2 NR 5 specified weaknesses	3 NR 4 specified examples of use	3 Yes 2 Partial 1 No; 1 NR
Role Playing, Ch.11, p.229		2 NR 5 specified strengths or uses	1 NR 6 specified weaknesses	1 would like to try later 3 NR 3 Not applicable/practiced/relevant	6 No; 1 NR
Jurisprudential Inquiry, Ch.11, p.249		4 NR 3 specified uses and strengths	3 NR; 1 not relevant 3 specified weaknesses	2 NR; 1 not practical 4 provided uses in class	1 Yes 1 committed to trying 4 No; 1 NR

Table B.11.a.4: III. Models of Teaching – Personal Family

Model	**Description: Professors defined each concept/model.**	**Strengths**	**Weaknesses**	**How I can use this model-describe**	**2006 Confirmations** **Y=yes, will continue** **P=partial, tried; will try again** **C=did not try, but committed** **N=did not, will not later**
Nondirective teaching, ch.12, p.271		3 NR 5 specified strengths	2 NR 5 specified weaknesses	4 NR 3 specified uses, with doubt	1 Partial 1 Committed to trying 5 No
Enhancing Self-esteem, ch.13, p.283		3 NR; 1 “Blah” 3 specified strengths	3 NR; 1 “Blah” 3 specified weaknesses	3 NR; 1 “Blah” 3 provided examples	2 Yes 3 NR; 1 “Blah” 2 No
Conceptual Development Ch.13, p.290		3 NR; 1 not in book 3 specified strengths	5 NR 2 specified weaknesses	1 specified examples of use 5 NR 1 feels too difficult to sue	1 Partial 2 Committed to trying 1 No 3 NR

B.10.2.5: **IV. Models of Teaching – Behavioral Models**

Model	Description: Professors defined each concept/model.	Strengths	Weaknesses	How I can use this model-describe	2006 Confirmations Y=yes, will continue P=partial, tried; will try again C=did not try, but committed N=did not, will not later
Mastery Learning, ch.14, p.303 Programmed Schedule, p.310 Programmed Schedule, 3.11 (task performance reinforcement)		3 NR 4 specified strengths or uses	2 NR 2 not practical 3 specified weaknesses	5 NR 2 will not use	1 Yes 1 Partial 3 No 2 NR
Direct Instruction, Ch.15, p.313		1 NR 6 specified strengths, especially "efficient"	1 Nr 6 specified weaknesses	2 NR 1 will not use 4 indicated already in use or applicable	5 yes 1 No 1 NR
Simulation, Ch.16, p.323 Training and Self-Training		1 NR 6 specified strengths or uses	1 NR 6 specified weaknesses or comments	1 NR 6 specified examples of use	3 Yes 3 No 1 NR
Social Learning, Ch.14 (includes training & self-training)		4 NR; 1 not in book 2 specified strengths	4 NR 3 specified weaknesses	1 will foster through group work 5 NR	1 Yes 1 Partial 2 No 3 NR

Table B.11.b.1: Individual Responses

Jule Dee Scarborough, Ph.D.

Foundation: Concepts that apply to Learning – *Models of Teaching*. Joyce, Weil, Calhoun (2004) **2006 Confirmations**

Concepts – Chapter 1, p.3	Description	Meaning for Me and my Practice	Changes I will make based upon my understanding of this concept?	Where will these changes "show up" in the teaching and learning experiences throughout the semester?	2006 Confirmations Y=yes, will continue P=Partial, tried;will try again C=did not try, but committed N=did not, will not later
Constructivism, p.12	Each professor provided a description or explanation of all concepts or models listed on this worksheet from their study of the book.	"Teaching by direct method (i.e. teaching the content) as well as discovery method (how to learn content) so that student can construct knowledge appropriately." "Needs to be improved." "Although I have to transmit knowledge to my students, I have also to look for the way how they will build up more knowledge." "Essential to the transferring of usable knowledge to the students, and to encouraging the development of knowledge." "Burden of gathering knowledge lies with students. As a teacher, I am going to provide the means of facilitating that process." "use groups to help students learn." NR	"Even though the current course has both methods, it is mostly direct method. Proposed change will bring in more discovery method to create a balance of these two methods." NR "The topics seen in my class require students to create knowledge. I already make students work in groups, but I have to plan better activities." "I will incorporate more assessments and lecture time to active learning and higher level of Bloom's." "-facilitate various modes of knowledge gathering environment for the students." "organized group project in performance task 3" "give them projects through which they can create knowledge."	"These changes will show up through lectures as well as performance tasks assigned throughout semesters." "Tinker Toys" "No sure after reading all chapters. I guess the topic of problem formulation could be the more appropriate." "Through the use of discussion groups, case studies, and structured performance tasks." "Throughout the duration of the course." "performance task #3 and final exam." "project"	Yes Yes Yes NR NR Yes Yes

Metacognition, p. 14		**"Student is encouraged to not only to master the subject but also understand the process of learning and applying it for other situations."** **"Need to improve." Students get ____a week later; not sure if the close the feedback loop."** **"My students should be provided of way to monitor their learning progress."** **"this is the key to the concept of lifelong learning."** **"Students should develop control over their learning processes rather than passively reacting to the environment."** **"must use assessment over wide range; good assessments must be employed."** **NR**	**"Explain to students not only the procedure to solve a particular problem but also how can it be generalized, e.g. converting a physical statement into mathematical problem. Provide immediate feedback."** **NR** **"Not sure about it. I think the assessment process is a valid way to provide students with that mechanism."** **"I will include activities that encourage them to think about how they are thinking."** **"-performance tests, groups discussions, self-reflection"** **"use test item bank to make sure all topics are assessed in exams."** **NR**	**"While solving problems, this approach will be followed, i.e. problem statement variables to be solved (generalization) as well as the procedure (content specific)."** **"Many examples of calculating movement and different ways of doing it."** **"Not sure."** **"Through the use of discussion groups, case studies, brain teaser exercises, and performance tasks."** **"Through the duration of the course."** **"Performance tasks 1-3 and midterm and final examinations."** **NR**	**Yes** **Yes** **Partial** **NR** **NR** **Yes** **Yes**

Scaffolding, p.14		**“Make the student more independent as they progress through the course.”**	**“Initial assignments will have more information but later assignments will have less information.”**	**“Assignments or laboratory exercises (such as Lab 1 and 2), most of the information will be provided in detail, but for laboratory 3, less information will be provided.”**	**Yes**
		“I only have a chance to do this when students come to see me – rare.”	**NR**	**“In class activities”**	**Yes**
		“I should provide these ways of metacognitive control.”	**“The idea of reciprocal teaching is something I would like to try.”**	**“I think problem formulation is the open place where I can incorporate this.”**	**Yes**
		“This is necessary if we want them to understand how to think.”	**“I will try this. I do not yet know exactly how this will unfold.”**	**NR**	**NR**
		“Providing students with support while introducing a concept or topic. The level of support will be reduced gradually as the students master the concept.”	**NR**	**NR**	**NR**
		“already being executed in classroom instruction.”	**“already in place”**	**“continually”**	**Yes**
		NR	**NR**	**NR**	**Yes**

Zone of Proximal Development, p.16 (optimal mismatches with tasks given to students)		**"Some mismatch so that the student is not too comfortable and yet not overwhelming so that the student is not frustrated."**	**"While explaining a problem, initially not much explanation will be given and students will be asked to participate to complete the problem (so that they are challenged). However if they cannot respond then instead of completely solving the problem, more hint will be given (so that they are not frustrated) to make them think and learn."**	**"For performance tasks students will initially work individually and since some are very rigid (stage I of Optimal Environment) to adaptable (state IV), they may face different challenges. However, when they work to arrive at best solution, they learn to be adaptable."**	**Yes**
		"Important! I don't do this now. Difficult to keep 70 students in zone. All have different paces."	**NR**	**"Perhaps ____(HW?)that progress."**	**Partial**
		"I should find the optimala environment for my students to work."	**"While they work in groups, I should observe them. I don't know how to kind of 'measure' this."**	**"I think in problem formulation.**	**Yes**
		"This facilitates the application and synthesis of knowledge needed to reach the higher levels of Bloom's."	**"These will be enumerated in the performance task goals and processes they will need to engage in to complete the tasks."**	**"This will be demonstrated through completion of the new performance task."**	**NR**
		"To provide students with tasks and problems that challenges them."	**NR**	**"-performance tests; open-ended items"**	**NR**
		"buld from simple concepts to more complex."	**"already in place."**	**"continually, lectures and student learning assignments."**	**Yes**
		"force them to 5-6 Bloom's level"	**NR**	√ (assumed yes)	**Partial**

Roles of Expert Performance, p.20		**"Have a broad vision in terms of [course content] teaching and implement in appropriate level."** **"Model good problem solving at board, but might do a better job of breaking it down."** **"This is what I try to accomplish in my class."** **"Essential to active learning and higher levels of Bloom's."** **"to challenge the student with higher level performance at the very beginning instead of allowing them to proceed progressively."** **"address projects to levels of 5 and 6 of Bloom's, mostly 6; strive for high goals."** **NR**	**"Keep focus on ultimate goal of designing for [course content] in various situations and ensure that the classes are eventually geared towards that goal."** **NR** **"No sure."** **"The students will need to engage in this to complete their tasks."** **"There is a possibiloity to introduce this concept."** **"give assessments that challenge students at Bloom's levels 5 and 6."** **NR**	**"Assignments are built around the central theme of designing for vibration and let students appreciate that."** **NR** **"Not sure."** **"This will be demonstrated and assessed through the use of the new performance tasks."** **NR** **"Performance tasks 1-3 at higher levels of Bloom's."** **NR**	**Yes** **Yes** **No** **NR** **NR** **Yes** **Yes**

Table B.10.3.2: I. Models of Teaching – Information Processing Models

Models	Description	Strengths	Weaknesses	How I can use this model-describe	2006 Confirmations Y=yes, will continue P=Partial, tried;will try again C=did not try, but committed N=did not, will not later
Inductive thinking, Ch.3, p.41 (classification-oriented)	Each professor provided a description or explanation of all concepts or models listed on this worksheet from their study of the book	Students may learn how and why various topics are organized and developed and then become able to generalize it. Helps students to see the pattern.	May not follow text book and thus text book may not be of as much help.	Make students classify a [field-specific] problem in terms of various categories [name and list], and approach solution accordingly	Yes
		Help students conceptualize; see patterns	NR	Categorize [gave course specific examples]	Yes
		It allows students to engage in inquiring and logical thinking	The support systems require a wide source of unclassified data.	I think in [course specific example] I could use this model. I should have to design an example where they can play with it.	Partial
		This model is very effective.	Very time consuming.	Through performance tasks-they must take their information and assimilate it, organize it, and decide how to use it.	NR
		It appears to be useful for classification purpose	NR	-classification of [course specific] problems in terms of design approaches	Yes
		Students are natural conceptualizers. Increases range of perception from which students view information.	Students must practice to think inductively; textbooks may not be oriented to method.	Classify items; yes, good for engineering [and technology] classes.	Partial
		NR	NR	Appropriate	Yes

Concept Attainment, Ch.4, p.59 (includes concept formation)		**Try to understand the underlying common theme from sets of data** **?** **Good to recognize common patterns** **Students must figure out the attributes of a category by comparing and contrasting examples that contain the attributes of the concept with examples that do not.** **NR** **Works best with loosely defined attributes** **NR**	**May take too long and may not be suitable for particular class** **I don't see any use for this in my class** **It is for simple concepts.** **Very time consuming.** **NR** **Most textbooks are not suitable for concept learning and toher sources of information must be found.** **Too long**	**NR** **NR** **I don't think I can use this model.** **I will not use this technique.** **NR** **Not appropriate** **No use**	**No** **No** **No** **NR** **No** **No** **No**

The Picture-Word Inductive Model Ch.5, p.77		**NOT in the book edition I had** **NR** **NR** **Aids in making connections between verbal and visual concepts** **NR** **Leads students to more and more complex tasks; provides multidimensional curriculum** **NR**	 **Takes time** **NR** **Mainly used for language** **NR** **Control of process is with instructor, not the student, mostly suited for lower grade students** **NR**	 **First week performance** **NR** **I will not use this technique** **NR** **Probably not useful** **NR**	**No** **No** **Not applicable** **NR** **To introduce symbols** **No** **No**

Scientific Inquiry, Ch.6, p.101 Inquiry Training		**Engineering, similar to science, is not historical fact. Inquiry including experimentation is needed to find the fact and that fact may change over period of time as knowledge progresses** **NR** **Provides high levels on Bloom's [Taxonomy]** **Necessary to be successful in any area of engineering** **NR** **Gradually leads students to more advanced topics. Brings students into scientific process.** **NR**	**It is complex and elaborate** **Takes time** **It is complex** **Very time consuming** **NR** **Data may not be interpreted properly to develop hypothesis. Instructor must have great in-depth knowledge, topic.** **NR**	**Home works or laboratory assignments can be formulated based on this. Used in performance assessments** **First wee performance** **I will use this method in one of the performance tasks; students will be able to learn from that experience.** **This will be accomplished through the use of the new performance tasks** **-[course specific] design problems with practical applications** **-investigation of a given problem within a [course specific] system** **Good, useful for engineering classes in group setting for performance tasks.** **Use in project**	**Yes** **Yes** **Partial; still committed** **NR** **Yes** **Partial** **Yes**

Mnemonics, Ch.7, p.131 (memory assists)		**Students realize that they can control and modify their own mental activities. Also, creativity is nourished through improvement of imaging capacity**	**Not so useful for topics where there is less need for memorization**	**Very little use. I can think of using it in [particular course] where [example of discipline-specific use].**	**No**
		Only see it valid for definitions such as [formula discipline specific]	**Same**	**Same**	**No**
		Applicable to simple concepts	**Less applicable to engineering**	**I don't think I can use this model.**	**No**
		Ties pattern to concept	**Better for lower level subject matter**	**I will not use this technique**	**NR**
		NR	**NR**	**-to remember names and numbers of various parts that are used within the system.**	**Partial**
		Students become more effective at memorizing; empowers students intellectually	**Attention must first be given to what is to be learned**	**Not appropriate**	**No**
		NR	**NR**	**Not useful in for college**	**No**

Synectics, Ch.8, p.155 (includes metaphoric activity)		**Occasionally may be useful to understand the underlying idea (example); may permit creativity.** **?** **Stimulate imagination** **Illustrates how things are connected, and eventually, if the path is long enough, they may no longer be related** **NR** **Enhances creativity of individuals and groups; builds feeling of community; combines easily with other models** **NR**	**Difficult to come up with examples which have completely different appearance but somehow explains the fundamental concept** **?** **Requires elaboration** **Very time consuming and very abstract** **NR** **High-achieving students reluctant to participate; students must be exposed to process repeatedly.** **NR**	**NR** **?** **This is something I would like to try. The book doesn't show how in case of science. Seems to have a lot of potential.** **I will not use this technique** **NR** **No appropriate, but used in lectures to connect what students learned elsewhere.** **NR**	**No** **No** **Committed to trying** **NR** **No** **Partial** **No**

Advance Organizers, Ch.9, p.187		**Easy for students and teachers to build the concept around this theme** **Efficient** **It is easy to implement and allows to present conceptual structure** **Good for tying together multiple concepts needed for the solutions to complex problems.** **NR** **Good for systematic education of students in a key idea of a field.** **NR**	**Not as effective if concepts are completely new** **NR** **It can easily drive to passive learning if not well planned.** **Time needed to set this up** **NR** **Content must be well prepared and organized; student must be prepared to learn.** **NR**	**This is applicable in my courses as students see the big picture and also how small pieces fit in that big picture** **This is what I do** **It is definitely applicable.** **This will definitely be used in lectures/scenarios to the multiple concepts.** **NR** **Already in use.** **NR**	**Yes** **Yes** **Committed to trying** **NR** **No** **Yes** **Yes**

Table B.10.3.3: II. Models of Teaching – Social Models

Model	Description	Strengths	Weaknesses	How I can use this model-describe	2006 Confirmations Y=yes, will continue P=Partial, tried;will try again C=did not try, but committed N=did not, will not later
Ch.10, Partners in Learning,p.205					
Positive Interdependence, p.211 "training effects"		Helps students to learn cooperatively. Each student has few tasks to master and thus can learn those well Individuals in group are rewarded when whole group achieves Help students learn collaboration. Stresses cooperation and the fact that all have an important role to play. NR Helps students learn to work cooperatively. Individuals are left with few tasks to master. NR	All students must participate equally. Group should be small for appropriate testing Tasks must be simple, e.g. spelling things that can be trained Students must participate equally. Current testing discourages collaboration learning. Difficult to assess how equally all have participated. NR All students must participate equally; groups must be smaller; current testing discourages cooperative learning [K-12 only-not higher ed] Groups must be small; current tests discourage group learning	Laboratory assignments and performance assessment NR Project works. Through cooperative learning and group activities. -performance tasks can be designed as group investigation (Partners in Learning comment) -some of the activities can be incorporated during group meetings Performance Task #3 Project	Partial Yes Yes NR Yes Partial Yes Yes

Structured Inquiry, p.221		Students learn effectively by this method because it is an active learning Motivating Students share ideas and viewpoints. Excellent, especially in the use of case studies at the higher education level. NR Conflicting viewpoints interest student; students learn to reason and negotiate and develop capacity for reflection. Students see conflicting points of view [and] make them	NR NR NR Need a good problem. NR Students must be both observers and participants; it requires firsthand activity in a real situation to collect data. NR	Used in homework and performance assessments All 3 performance tasks Completely applicable. I already do this-it will be included in the solving of the case studies. NR All performance tasks NR	Yes Yes No NR No Yes Committed to trying later

Group Investigation p.213,14-227		**Proven effective way of learning** **Proven effective** **Students are taught democratic process.** **Group work is beneficial in many ways—here the method of inquiry is particularly important.** **NR** **Teaches democratic process; enhances social education of students.** **NR**	**Possibility that not all students are equally participating** **Have to manage group issues.** **Instructor must have high level inter-process skills.** **Constrained by structure in the group.** **NR** **Instructor must have high level of personal and instructional skills; process is slow and cumbersome; have to manage group conflict.** **NR**	**Used in performance assessments** **Performance tasks; inductive activities in class** **It has potential.** **Some of this will be accomplished through group performance tasks.** **NR** **NR** **NR**	**Partial** **Yes** **Partial** **NR** **No** **Yes** **Yes**

Role Playing, Ch.11, p.229		**Understanding empathy, conflict resolution, how to listen to other students** **NR** **Great value for developing empathy.** **Great to tie together interdisciplinary concepts—such as language and math.** **NR** **Gives greater understanding and empathy; allows for conflict resolution uniquely encouraging listening to other students.** **Gives better understanding**	**Lot of classroom time needs to be devoted** **Not Relevant** **Requires a great deal of time in classroom.** **Very time consuming and get these types of activities prepared for technical classes at the higher education level.** **NR** **One problem is that role playing requires in-depth treatment that needs a great deal of classroom time.** **Requires a great deal of time in class**	**NR** **NR** **Not applicable.** **I would like to try this in the future.** **NR** **Not practiced** **Not relevant**	**No** **No** **No** **NR** **No** **No** **No**

Jurisprudential Inquiry, Ch.11, p.249		**May help understand application in the context of possible litigation. Also issue of ethics can be discussed this way.** **NR** **NR** **Approaches problem solving from the argumentative side—one looks at a problem and a solution from more than one angle.** **NR** **Helps people rethink their position of legal, ethical, and social issues; gives tools for debates.** **NR**	**Need to find appropriate and relevant cases** **Interesting, but not relevant** **NR** **Very specific in form. However, I see the use for the multiple side concept. Perhaps this can be done without a "court case".** **NR** **One of the difficult tasks is for the instructor to integrate case details into a larger social issue.** **NR**	**If an impact problem has to be addressed (course applicable example that works to explain the application)** **NR** **To incorporate ethics.** **I would like to try this in the future without the constraints of a "course case".** **NR** **Not practical; linked to ethics.** **Ethics**	**Yes** **No** **No** **NR** **No** **No** **Committed to trying later**

Table B.10.3.4: III. Models of Teaching – Personal Family

Model	Description	Strengths	Weaknesses	How I can use this model-describe	2006 Confirmations Y=yes, will continue P=Partial, tried;will try again C=did not try, but committed N=did not, will not later
Nondirective teaching, ch.12, p.271		Greater personal interaction for individual growth of students. Apparently favored by African American students NR NR Students become engaged. NR Students' consciousnesses are raised, helping to clarify their ideas; student is free of pressure or coercion; student is helped to grow as a person Students free of pressure	Cannot be planned beforehand. Time consuming. Also question is how much role of counselor should be played by instructor More of a one-on-one thing as situations arise, rather than something that is planned NR Time allotment. NR Success depends on nurturing; may result in conflicting roles for the instructor-disciplinarian; replace friend, instructor, etc.? Very time consuming. May result in conflicting rules of instruction	If needed, use on a case by case basis. NR NR This can be done through group work and discussion sessions. NR Probably not practical, except to respect all questions from the students. More advising issues	Did not try, but committed to try later No No NR No No Partial

Enhancing Self-esteem, ch.13, p.283		**Not cut down the students** **BLAH** **NR** **Relates ability to function in the outside world to how they are approached inside the classroom.** **NR** **Students gain strength to learn on their own; more skills are developed and skill set widens to be able to master even greater skills.** **NR**	**Need to be administered carefully** **BLAH** **NR** **Not easy to accomplish or measure. Perhaps the use of learning inventories can aid in the instructor's abilities to help with this task.** **NR** **Students must be more proactive to benefit and draw knowledge from environment. Passive students will be by-passed by this learning process.** **NR**	**I always tell in class that no question is stupid question** **BLAH** **NR** **I will strive to relate the idea of lifelong learning. "They can do it."** **NR** **Probably not practical, except to respect all questions from the students.** **Encourage students to ask questions**	**Yes** **BLAH** **NR** **NR** **No** **No** **Yes**

Conceptual Development Ch.13, p.290		**Not in edition of book I have** **NR** **NR** **Gets students to "think outside the box", or their comfort zone.** **NR** **Students grow and develop rich orientations for growth. New experiences are tolerated and bring about new ideas and thoughts, rather than the existing state.** **New experience is tolerated**	**NR** **NR** **NR** **Not easy to accomplish or measure.** **NR** **Less developed students will spend more time trying to survive in new environment rather than learning from it. Need to balance areas of knowledge.** **NR**	**NR** **NR** **NR** **I will try to get them to think outside the box and incorporate their new knowledge. I believe that performance tasks and discussion sessions can play a vital role in this.** **NR** **Difficult to use in engineering [and technology] classes.** **NR**	**Partial** **NR** **NR** **NR** **Committed to trying** **No** **Committed to trying later**

Table B.10.3.5: IV. Models of Teaching – Behavioral Models

Model	Description	Strengths	Weaknesses	How I can use this model-describe	2006 Confirmations Y=yes, will continue P=Partial, tried;will try again C=did not try, but committed N=did not, will not later
Mastery Learning, ch.14, p.303 Programmed Schedule, p.310 Programmed Schedule, 3.11 (task performance reinforcement)		Pace appropriate for individual learning style and pace Lets students work at a pace which is appropriate for his/her learning style NR Students demonstrate proficiency before they move on, and fundamental building blocks are not passed by. They do not get "left behind". NR Instruction in encouragement role; positive effect on students; students work at different paces to learn. NR	Progress of class may be hindered due to some individual student's inability to progress Impractical for [my course] NR Not practical on a large scare for larger classes. NR Students require different of times to master material; only modest increase in student learning; no improvement on tests. Progress of class is slower	NR NR NR I will not use this technique. NR Not practical; can't keep up all students. NR	No Partial NR NR No No Yes

Direct Instruction, Ch.15, p.313		Efficient, fast, has been used traditionally Efficient Efficient and fast Good for lower level subject matter. NR Solid method; good history of getting results Efficient	Limited participation from students (less encouraging) Not engaging It might not be engaging Not practical for high level material. NR Limited participation from students; students do not answer or question. Less engaging	It is used already NR Applicable I will not use this technique. NR Already widely used in course. What we do	Yes Yes Yes NR No Yes Yes
Simulation, Ch.16, p.323 Training and Self-Training		Use software effectively for simulation Authentic; learn by doing Students can develop skills equally Connects concepts to actually "doing" and the real world NR Students play roles of real people engaged in real life actions Can see for themselves	Need to be careful if the software is good or providing correct idea More natural to do in some classes than others Software package Time consuming NR Most models depend on good software packages; difficult to blend into curriculum. Depends on software quality	Use software such as Matlab [Course specific example] is a simulation of sorts It has been used in engineering I already implement simulation techniques. NR Not useful for course Labs	Yes Yes Yes NR No No No

Social Learning, Ch.14 (includes training & self-training)	**Coop Learning**	**Not in my book** **NR** **NR** **This goes hand-in-hand with simulation** **NR** **Nearly all students can master tasks and achieve a given set of objectives.** **NR**	**NR** **NR** **Not easy with certain types of personalities** **NR** **Must manage class as to reorganize curriculum to give enough time for each student to learn.** **Time consuming because you have to give**	**NR** **NR** **I will foster this through group discussion sessions.** **NR** **NR** **NR**	**NR** **Yes** **NR** **NR** **No** **Partial** **No**

(Copied from GAPS Analysis – Teaching Models Data Embedded; See pages 43-47)

GAPS Analysis Summary (Fall 2005 and **Fall 2006**)

Jule Dee Scarborough, Ph.D.

Student Learning Statements (Outcomes)

In the initial analysis of the Fall 2005 courses – where we began, professors used their existing course syllabi. Although as a college, we had improved our student learning statements during the accreditation process, they remained rather unorganized and weak in content and appropriate expression. The learning statements were expressed in mixed modes across syllabi. Some learning statements were written as course objectives; others were written as student learning objectives; yet others were written as more outcome-oriented statements. However, in generalizing, many and sometimes most of the student learning statement formats across syllabi were not active, clear, measurable, or clearly outcomes-oriented, where the professor and student could ascertain exactly what was expected and would be measured, and/or determine the culminating grade. Three professors expressed the learning statements in a way where students could see that there was a relationship between student learning outcomes and the ABET or NAIT outcomes, but if the ABET or NAIT outcomes were identified by a letter and not stated, then the relationship was not clear, nor were students about to review the accreditation outcomes for their own information. Two professors expressed the statements more clearly, with written statements for both the national standards and the learning outcomes for the course. The other five professors did not show the national statements in narrative but rather identified them by letter or number, regarding the level of coverage and depth of relationship. This had little meaning for students and did not make it easy for the professors to clearly be assured of direct links and relationships. Generally, the statements did link to the ABET or NAIT standards or outcomes, but often not clearly or strongly. It would have been difficult to determine a direct link, especially in light of the student learning assessments being used for the 2005 course. Therefore, we examined the 2005 syllabi and course content related to the standards as well as we could, with the understanding that the student learning outcomes to be redeveloped would better and more clearly and directly link to the national standards and assessments – a two-way link revealing the critical knowledge and skill connections.

Below are two charts that broadly identify the standards addressed in the Fall 2005 courses, according to the content and syllabus analysis by each professor of his/her course. The data are presented (in black) as collapsed across either all engineering professors or engineering technology professors as a broad viewpoint. The **Fall 2006** courses are presented in red, and although there are minor differences in the number of standards addressed, there is a great and very significant difference in the quality of the learning statements and their direct links to both the national standards and the learning assessments. The tables also reflect the number of learning outcomes for each standard by professor, **2005-2006** when possible. For the **2006** courses, the professors not only have improved wording and expression, but the knowledge and skill connections are much stronger; in addition, the outcome statements are improved because they are broken out into primary, second, and third level statements. The quality is improved not only because of better wording, but also because they now better understand the difference

between complex statements, where there is a cluster of outcomes inherent to a single primary outcome statement. Thus the course content or the knowledge and skills to be taught became more obvious in the inherent breakouts of second and sometimes third level outcomes. This provided insight and assisted the professors in understanding what underlying or inherent knowledge and skills were required for a complex cluster of difficult primary learning outcomes – in other words, the knowledge and skills inherent to a single complex primary outcome. Therefore, readers may be amazed at the number of changes that resulted.

Usually, the primary statements would be used on syllabi or other reporting documents, but the analysis and breakout of second or third level learning statements provided a great learning experience for professors and led them to design and then engage students in more intentional, thoughtful, and higher quality learning experiences. This analysis and process can lead to more astute teaching and student learning, student assessments, instructional choices, learning process decisions, and more. Remember, each <u>course</u> is not required to address every national standard or outcome, but instead the standards or outcomes of focus selected should be addressed well. It is important that they understand individual course versus program requirements, that there is a cumulative effect across courses for the entire program, that the overall <u>program</u> is required to address all national standards or outcomes, not any single course; therefore, many standards will be addressed across multiple courses. However, particular standards may be addressed in only one or two courses across the program, depending on content, depth, program level, (e.g., introductory or capstone course). Professors sometimes mistakenly strive to address all or too many outcomes; thus the course content can become weak or superficial. Finally, when identifying the objectives or outcomes listed below, an * is used where one objective or outcome covers more than one ABET outcome or NAIT standard or where there is a greater total of "1s" than the total in the number in parentheses (4). The determining factor is the level of coverage of content.

Regarding outcomes, it is important to note that the professors analyzed the engineering or technology course content for embedded NIU General Education Goals. This analysis led them to more deeply understand why students fail to perform well in their courses if they do not come to the course with the appropriate general education knowledge and skills that are the underlying foundation for the engineering and technology content. The program leader revealed the strong relationships between NIU General Education Goals (outcomes) and the ABET and NAIT standards or outcomes by aligning and inserting them into a worksheet. That made it much easier and more efficient for the professors to see the direct relationships, then to consider the importance of acknowledging the embedded general education goals/outcomes as part of their course content, and to realize that even though they are teaching engineering or technology courses, they are actually concurrently continuing, extending, expanding, and deepening the learning of general education content in the context of engineering and technology. This was extremely important. Our professors intuitively knew this but had never "studied" the connections, mapped the connections, or included the general educational goals aligned beside their engineering or technology outcomes. They had also never thought of themselves as continuing the learning of the general education knowledge and skills in engineering and

technology content. They considered the general education math, science, and communication knowledge and skills as prerequisites and only dealt with them when students did not have the knowledge or skills needed to perform on the engineering and technology content. Now the professors understand that they actually continue the learning of the mathematics, science, communication, etc. content in the engineering and technology context. The chart below reflects the 2005 course in black and the changes for the **2006** course in red. The professors improved the outcomes and connections and are committed to greater depth of change for the future. This was a very successful program component, resulting in significant learning and change.

Assumptions
Beware of assumptions when scanning the chart below and noting that one or more course outcome numbers did not seem to change. For example, one professor's number of outcomes did not change from 2005-**2006**; however, the quality of the outcomes for **2006** was very significantly different and improved. Also, that professor's four primary outcomes were broken out into second and third level outcomes. Again, for example, one primary outcome inherently encompassed five secondary outcomes, with each of those broken out into a third level. Thus the quality in content, linkages, and assessments was dramatically different and greatly improved for most of the courses.

Table B.11.c.1: Standards ABET-Engineering Outcomes (Fall 2005 and Fall 2006 courses) (5 engineering professors)

a. apply math, science, engineering	b. design/ conduct experiments; analyze, interpret data	c. design system, component, process-given constraints, etc.	d. function on inter-disciplinary teams	e. identify, formulate, solve engineering problems	f. understand professional, ethical responsibility	g. ability to communicate effectively	h. understand impact eng. Solutions on global, economic, environment, society	i. recognition of need for, and ability to engage in life-long learning	j. knowledge in contemporary issues	k. ability to use techniques, skills, and modern engineering tools
Fall 2005 and Fall 2006 Courses – ABET Outcomes										
5 + 5+	2+ 1partial (no DOE) 1 NR 1 c 2+	4 + 1+partial (could do lots more) 1 c 4+	1+ 1 NR 3 c 2+	4+ 1c 5+	1+ 1+ (written reports only) 1 NR 2c None	1+ 1 3c 3+	1+ 1 NR 2c 1c (minor) 1+	2+ 1+ (to small effect) 2c 2+	4+ 1c 4+	4+ 1+ (students don't use unless asked to) 5+
(6-11) 1 - 4 (3/6--5) 1-5 (4-4) 1 - 1 (4-5) 1 - 5 (4-5) 1 - 2	1 - 1 * -none	1 - 2 1 - 1 1 - none 1 - 5 1 - 1	1 - 1 * - none 3	* - 8 1 - 5 1 - 1 1 - 5 1 - 1	* - none * - none * - none	1 - 1 * - 1 1 - 3	1 - none * * - none	* - none * - 1 * - 1	* - 2 * - 1 * * - 1 1 - 1	* - 3 1 - 1 1 - 1 1 - 2 1 - 1

Legend: + = yes-okay; c = need to consider; other notes

Table B.11.c.2: Standards ABET/TAC/NAIT-Engineering Technology & Industrial Technology
(2 engineering technology/technology professors) (Fall 2005 and Fall 2006 courses)

a. mastery of knowledge, techniques, skills, modern tools	b. ability to apply current knowledge; adapt to emerging applications of math, science, technology	c. ability to conduct, analyze, interpret experi-ments; apply experiment al results to improve processes	d. ability to apply creativity in design of systems, components, processes	e. ability to function effectively on teams	f. ability to identify, analyze, solve technical problems	g. ability to commu-nicate effectively writing	h. ability to com-municate effectively orally	i. recognize need for, ability to engage in lifelong learning	j. ability to under-stand profes-sional, ethical, social responsi bilities	k. respect for diversity; know-ledge of contempor ary profession-al, societal, global issues	l. commit to quality, timeliness, continuous improve-ment	m. ability to program computers and/or use computer application s effectively	n. ability to use modern labor-atory tec-niques, skills, equip-ment effect-tively	o. ability to manage projects effect-tively	p. ability to design, mani-pulate, manage industri al systems q. ability to manage or lead person-nel effect-tively
Fall 2005 and Fall 2006 Courses – ABET/TAC/NAIT Outcomes															
2+ 2+	2+ 2+	1+ 1c 2+	1+ 1c 2+	1+ 1c None	2+ 2+	1+ 1c 2+	1+ 1c None	1+ 1c 2+	1+ 1c 1+ ? not sure	1+ 1c 1+	2+ 1+	2c 1+	1+ 1c 1+	1+ 1c None	p. 1 no re-sponse 1c None q. 1no re-sponse 1c None
(5-6) 1-6 (6-19) 1-10	1 - 5 1 - 5	1- 1 * - 5	* - 1 * - 3		1 - 4 1 - 6	6 1		* - 4 4	2 1-one	1 1	2 *-none	1	1 – 1	 *-none	p. * -NR NR-NR q. *-NR NR-NR

Legend: + = yes-okay; c = need to consider; other notes

Table B.11.c.3: NIU General Education Goals (Fall 2005 and Fall 2006) (7 professors across engineering and technology)

Writing	Speaking	Listening	Quantitative Reasoning	Use of Resources-Technology	Historical Development Of Culture	Significance of Arts	Cultural Traditions Philosophical Ideas	Methods in Science Methods in Social Science	Interrelatedness Across Disciplines	Social Responsibility Citizenship
C C+ Earlier it was only lab reports. In fall 06, they had to write reports for three PA tasks.	C C+ Presentation of PA tasks	+ + Listen to guest speaker, professor, fellow students during PA task presentations	+ C+ Homework, exams, PA tasks – all involved quantitative reasoning	+ + In addition to labs that required using many resources, had to use outside resources for PA tasks.	NR NA	NR NA	NR NA	NR NA	NR C May consider more interaction with EE for signal processing	NR C+ Discussed issues such as energy conservation, noise, pollution, ethics, etc.
C+ Did consider and add, still needs improvement; will keep working on it	C	?	C+ Strong, but could be better	+ I'm quite pleased	NA	NA	C-	C+	C	C
Ok + Project, exams, homework, using MS Word	C + Oral presentations with PowerPoint	C C-	Ok + Material requires this	Ok + Software and computer to solve problems	NR NA	NR NA	NR NA	C NA	Ok, C+ Examples, exercises with topics from other disciplines	C C-
+ + PAs and homework	+ + Pas and discussion sessions	+ + Lectures, case studies, discussion sessions	+ + Problem solutions, homework, midterm and final exams	+ + PAs and homework	C NA	C NA	C NA	+ + Problem solutions, homework, midterm, final exams, and PAs	+ + Case studies and PAs	+ C-
C - + well addressed through PA reports	+ NA- possible to include for future course	C + lectures	+ + addressed in project design decisions	C + well addressed through project design decisions	NR NA	C + addressed through project design	NR - NA	C + well addressed through project design	C C+ to some extend when making design decisions	C C- possible to include for future courses
+ + Performance Tasks	+ + Group learning and interactions	+ + Group interactions	+ + Performance tasks, lab demonstrations	C NA	+ C+	C + Lectures	+ C+	+ NA?	C C+	+ C+
C +	C C-	C C-	+ N+	+ +	+ NR	C NA	C NA	+ NA	C NA	C N\A

Legend: + addressed well; NA-does not really apply in professor's opinion; C- do not do it, but still need to consider adding it in as professor continues to make changes; C+ did consider and add in; still needs improvement and professor will keep working to improve or add;

Research Semester Results on Teaching Styles (Fall 2005 and Fall 2006)

During the initial course analysis, professors analyzed their 2005 courses for use of teaching styles. They referenced Mosston and Ashworth (1990) only. At the end of the research semester, professors were provided the same Teaching Styles list by Mosston and Ashworth and also Grasha's (1996). They were asked to consider which styles were used during the research semester. The responses ranged from check-offs to comments. Mosston and Ashworth's styles are compared for the 2005 and 2006 courses on (Table 5) below the one for Grasha (Table 4). The results from considering Grasha's are presented in the chart immediately below in narrative. Some professors estimated how many times they used each style; others made comments about the ones they choose; and others did both. All professors made comparisons using Mosston and Ashworth's teaching styles, but some professors also considered Grasha's Mosston and Ashworth were provided during the initial analysis early in the program. Later in the program we were trying to present them with varying options and perspectives. Therefore, they were also exposed to Grasha's styles. The most important aspect of this reporting activity was to reinforce consideration of teaching styles and to stimulate a broader repertoire of teaching styles or the use of a greater variety of teaching styles in their courses. Grasha is presented first. **Note: Outcomes vary across professors, so the two tables, Grasha and Mosston and Ashworth, reflect which teaching styles are used across the total of individual primary course outcomes by professor. Outcomes are presented by number only in left column. This program component was very successful in that professors varied their teaching styles beyond those used in their 2005 courses.**

Table B.11.c.4: Student Learning Outcomes & Teaching Styles (Fall 2006) (7 professors across engineering and technology)

# of Outcomes	Expert	Formal Authority	Personal Model	Facilitator	Delegator
6	Yes -4	Yes – 5	NR	Yes – 6	Yes - 3
3-6	Used Felder formally	NR	NR	NR	NR
	Responded to Kolb				
4	Yes	Yes	NR	NR	NR
	Used Kolb formally				
4	Yes, but used less this time	Used for fundamentals	NR	Used with PA tasks, especially 1 & 2	Used for final PA task #3
	Used Kolb formally				
5	No Response to Grasha	NR	NR	NR	NR
	Responded to Kolb				
6	No Response to Grasha	NR	NR	NR	NR
	Responded to Kolb				
4	Yes	Yes	No	Yes	Yes
	Responded to Kolb				

Table B.11.c.5: Student Learning Outcomes & Teaching Styles (Fall 2005 and Fall 2006)
(7 professors across engineering and technology)

# of Outcomes	Command	Practice	Reciprocal	Self-Check	Inclusion	Guided Discovery	Convergent Discovery	Divergent Production	Learner Designed	Learner Initiated	Self Teaching
6	6+ yes -10	6+ yes-4	2c, 4+ yes -5	6c-1min.	6c	5+, 1c yes -20	6c	3c (min) 3c yes -6	6c	6c yes -1	6c
3-6	6+ Less than before	6c Much more	5c, (1 little) a few times; did not guide ob.	6c more than normal	6c	3+, 3c more than before	1can do more 1+, 4c more than before	5c, 1little	6c	6c more than before	6c more than before
4	2ok yes	2ok,c yes	2c yes	2c	2c	NR	2c yes	NR	NR	NR	NR
4	4+ used less this time	4+	2c, 2+ used much more during oral discussions	4c	4c new, somewhat accomplished through implementation of the rubrics	4c	4c used much more – a lot through PA tasks, discussions	4c	4c	4c	4c
5	5+	5some used appx. 6 times mainly/PAs	NR	4+(1some)	4c, 1NR	3c, 2NR	3c, 2NR	NR used appx. 12 times / problem solving	NR	4NR,1c	NR
6	5+, 1c yes - 20	5+, 1c yes - 6	6c yes - 6	6c	6c	3+, 2c	5c, 1+ yes - 3	5+, 1c	5c, 1+	6c yes - 3	5+, 1c
4	4+ no; but, yes with other styles below	4+ yes, when solving problems in class	4+, c within the group; but without professor supervision	4c yes; feedback within group	NR yes	4c+	4c+ yes	4c yes, sometimes; when the was design problems	4c yes	4c yes, but with some guidelines; instruction is given	4c yes, with projects; but not with deep consultation

*Research Semester Teaching Models (Fall **2006**)*
In the table below, the professors' analysis of their Fall 2005 course is compared to what they indicated actually occurred in the same, but significantly revised, course during the research semester of Fall **2006**. The Fall 2005 course is presented first in black, and beneath that information, the teaching models used during the Fall **2006** course during the research semester are presented in red. There are 24 teaching models; therefore, the complete list is presented in two charts; models are identified across the first row. The numbers in black represent what they would consider using, acknowledging that in the 2005 course those were not in use. The number or comments in red represent what they felt they tried in the 2006 experimental course.

Although it may appear that professors selected only a few new models to use during their experimental course in 2006, remember there are 24 different models to consider. They were encouraged to select just a few models to try out in the 2006 courses, and then to add other models gradually in consecutive semesters. Thus, each professor chose a few models to try that were different than the most-often used "lecture" model.

This aspect of the program was successful: professors were exposed to 24 teaching models. They used this initial approach to analyze what models they felt were used in the 2005 course. Most of them had no previous knowledge of these models nor had they considered "teaching models" at all, even those who had attended teaching workshops. Several had been exposed to "cooperative learning," one of the teaching models below, but had not used the model formally at all and only weakly structured informally.

During the teaching model program component, the professors studied the 24 models more in depth; this was after the initial analysis with a list and brief descriptions. The worksheet used as a study guide along with the Joyce, Weil, and Calhoun's (2004) *Models of Teaching* book reveal how they felt about each model and whether they felt each model had potential for use in teaching their course. That worksheet is presented later, as it is a formal segment of the program for the redevelopment of the course. However, when reviewing the worksheet, each professor's comments, and then the comments after the experimental course, one can see the growth, comments, or questions.

After the research semester, Fall 2006, we returned their initial analysis and the study worksheet and asked them to note which teaching models they felt they had actually used during the experimental semester. Did they use the ones that they expected to try out? Did they use others not expected? The red numbers below labeled 2006 are those responses. The data reveal significant change, considering the context was one course and their first effort to expand their teaching model repertoires.

(See Teaching Models In Portfolio Section B.11)

Table B.11.c.6: Student Learning Outcomes & Teaching Models (Fall 2005 & Fall 2006) (7 professors across engineering and technology)

# Out-comes	Memory	Progressive Part	Advanced Organizers	Lecture	Reciprocal Teaching	Mastery Learning	Cooperative Learning	Graphic Organizers	Concept Attainment	Concept Formation	Concept Presen-tation	Conceptual
6	6c	6c	5c,2+ yes 20+	6+ yes 10	6c (1min.)	5c, 1+	3+, 3c yes 3	3+, 3c (1min) yes 4	6c (1min)	6c (1min)	6c	3+,3c yes 6
3-6	6c	6c couple times liked it	6c have always used it	6+ do much less	6c several times	6c used, not completely rigorous	6c used much more & more formal	6c (1 min) used about as much as before	5c,1+ used…probably slightly more	6c	6c used a little	6c used
4	NR	2c yes 14	2c yes	2+ yes 14	2c yes 7	2c yes 10	2ok,c yes 7	2c	NR	NR	2c yes	2c
4	NR	NR	NR yes, good response	4+ yes, several times	2c, 2+	NR	2c, 2+ yes, good response, more assessments taken the time	4c	4c	4c	4c *Used with *C, more often than before; now I know what this is called.	4+ **** used with * CP
5	2+	4+	4+	4+ 20-used frequently to deliver course materials	4c 3-used while executing PAs; demon-strated good outcomes.	NR	4c 3- used to enhance implementation of PAs	4+	NR	NR	3c,1NR	4c
6	5c	4+,2c 15 lectures	4+, 2c 3 theory linked with lab demon-stration	5+, 1c 20 lectures	6c	6c	6c 6-group learning & PA#3	5+,1c 10-during lectures-visual aids	6c	6c	2c, 4+ 6-lectures on funda-ment	4+,2c
4	4c used, but not much	4+ yes	4+ yes	4+ some parts lecture, but not majority	4c did this with projects	4c	4+ yes, done with PA projects	4c yes, every group did that	4c	4c	4+	4+

# Out-Comes	Inductive	Deductive	Inquiry	Simulation	Jurisprudential	Direct Instruction	Training	Synectics	Psychomotor	Metaphore	Non-Direct	Role
6	6c yes 4	6c (1min)	6c(2min) yes 5	6c(2min) yes 2	6c	4+,2c(1min) yes 8	4+, 2c yes 5	6c	5NR,1c yes 2	NR yes 1	NR yes 2	NR yes 2
3-6	6c used a lot	6c used less than before	2+, 4c used a lot	6c extensive use	6c	6c	1+, 5c about as before	6c	6c some	6c	6c	6c
4 NR→	NR	2ok	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
4	4+ used much more; students responded well! Used past also.	4+ used much more; students responded well! Used past as well.	NR	4c	NR	NR	NR done some before; use-ful for pro-blem solving procedures; excellent / conceptuali-zation; able to discuss different approaches after one as presented.	NR	NR	NR	NR	NR
5	NR	NR	4+ 7	4c	NR	4c 10 suitable for certain topics	1c, 4NR	NR	NR	NR 3	4c	1c, 3NR
6 .	6c 9 – Pas & assignments	6c	6c	4+, 2c 2 lab demos	6c	2+, 4c 15 lectures on basics	5c, 1+ 2 lab demos	6c	5c, 1+	6c	6+	5c, 1+
4	4c yes, hidden in lecture	4+ yes, but professor dos that when needed	4c	4c yes, students simulate perfor-mance of rubrics	4c	4c	4c	4c	4c	4c	4c	4c

(Scarborough, 2006 based on Joyce, Weil, & Calhoun, 2004)

Student Learning Outcomes & Kolb (1984) Learning Styles

The Chart below identifies what learning styles, according to Kolb's (1984) styles, the professors felt they were providing opportunity for students to use in both the 2005 and **2006** courses. It appears that more attention was paid to learning styles across professors in the 2006 experimental course. Two professors used the Kolb Learning Styles inventory formally with the entire class, and a third professor used the Felder Learning Styles Inventory formally with his/her class. This segment of the program was also considered very successful, as it greatly enhanced the professors' understanding of the overall focus of teaching and the relationship between teaching styles, teaching models, and student learning styles. Their awareness was greatly increased; their understanding increased; and, their commitment to working on increasing the diversity of teaching models and styles to better engage a broader range of student learning styles and to also culminate in expanding individual student learning styles was significant. Below are reflections from the three professors who formally used LS Inventories. (See Felder notes)

Table B.11.c.7: Student Learning Outcomes & Kolb Learning Styles 2005 & 2006 (7 professors across engineering & technology)

# Outcomes	**Concrete Experience**	**Abstract Conceptualization**	**Active Experimentation**	**Reflective Observation**
6 **Also used Felder's SL, IL, VL, VL, AL, RL, GL.**	**2c-minimal, 2c, 2+** **yes**	**5+, 1c** **yes**	**3c, 3+** **yes**	**6c** **yes**
3-6 **Used Felder's only. The notes are ture for the concept tests, but less so on the problem solving tests. See write up below.**	**6+** **Global learners did better than sequential learners.**	**3+, 2c** **Intuitive learners did Better than sensing learners.**	**4+, 2c** **Visual and verbal learners did equally well.**	**3+, 1 not so much, 2c, 1 a little** **Reflective learners did better than active learners.**
4 **Formally used Kolb with students as a way to show students their learning styles. Will use it next time to also create activities tailored to students' distribution of L. styles.**	**NR** **yes**	**2ok,c** **yes**	**2ok, c** **yes**	**2c** **yes**
4 **Formally used Kolb's Inventory.**	**2c, 2+** **Yes** **Concentrated effort was**	**4+** **Yes** **made to have activities**	**4+** **yes** **to engage all four (4)**	**4+** **yes** **learning styles.**
5	**5+**	**1NR, 1+, 3c**	**1NR, 1c, 3+** **yes**	**4+, 1c**
6 **No response**	**6c**	**5+, 1c**	**5c, 1+**	**4+, 2c**
4 Also used Felder's SL, VL, VL, AL, RL, SL, GL	**4+**	**4+** **yes**	**2c, 2+** **yes**	**2c, 2+**

Legend: **Black-Kolb 2005 course analysis;** **Red-2006 course analysis;** **Blue-2006 course using Felder**

Reflections on using Felder & Soloman Learning Styles

B.D. Collar

In the fall of 2006, we conducted a research project experimentally investigating student learning in an introductory engineering mechanics course. As part of the project, we administered Felder and Soloman's Index of Learning Styles. The survey is designed for engineering undergraduates. It consists of 44 questions aimed at illuminating students' preferred modes of learning. Felder and Soloman characterize student learning styles with four dimensions:

1. *active vs. reflective,*
2. *sensing vs. intuitive,*
3. *visual vs. verbal,*
4. *sequential vs. global.*

In the research project, we randomly split the class into two groups. With one group, we used hands-on manipulatives to present many of the concepts. The second group is a control group in which we used more traditional graphical techniques to introduce and solidify concepts.

As it turned out, there was no statistically significant difference in the two groups' performances on objective performance tests. However, when we examined the data more closely, we did find an interesting distinction. Electrical engineering students in the experimental group did significantly better than their counterparts in the control group. It was an effect not present in the mechanical engineering students, who make up the bulk of the class. In fact mechanical engineering students in the control group tended to do slightly better than their counterparts in the experimental group, but not by a statistically significant margin.

It is apparent from our data that electrical engineering students think and learn differently than mechanical engineering students. An obvious question is what makes the electrical engineering students more receptive to the hands-on teaching strategy? When we correlated students' learning styles to exam performance, we found that

1. *Reflective learners tended to perform better than active learners.*
2. *Intuitive learners tended to perform better than sensing learners.*
3. *There was no correlation between the visual/verbal dimension of learning and exam performance.*
4. *Global learners tended to perform better than sequential learners.*

In results 1, 2, and 4 above, the p-values were all less than 0.002. However, all correlation coefficients had magnitudes on the order of 0.4. Therefore, while certain learning styles showed a tendency for better performance, it is clear that there was no definite one-to-one correspondence. So are the more advantageous learning styles more prevalent in electrical engineering students? The answer is no.

We found no statistical difference between the learning styles of electrical and mechanical engineering students. In the study, we tested for several other differences between mechanical and electrical engineering students that also correlated with exam scores. We were not able to find any. For now, the difference is a mystery.

Application of Kolb's Learning Styles to ISYE370

By Reinaldo Moraga

I started my Operations Research class –ISYE370– by giving the Kolb's learning inventory test to my students in such a way that they and I became aware of the type of learning style they used to learn and which other styles they were able to pursue. In addition, Kolb's learning styles helped me to improve the delivery of the teaching.

The test was given to each student in the first class after the presentation of the syllabus. Then I explained to them the importance of recognizing their preferred learning style and how this information could be used for them and me to enrich the learning environment in the classroom. In addition, I tried to connect the importance of this tool with their professional career in terms of communicating in the workforce and collaborating in groups. Step by step, I went through the booklet to let them know how to fill the questionnaire and interpret the results. The students were inclined to think that there was a correct outcome for this test. Therefore, I had to make clear that this was only a way to diagnose a <u>preferred style</u> of learning. Finally, I asked to take the test home, answer the questionnaire, and next class give me a brief essay reporting (a) their preferred learning style, (b) actions they could take to expand their learning into other styles, and (c) which type of activities in this class could produce connection with their preferred and other learning styles.

Most of the students were able to identify their preferred learning style. To expand their learning styles, most of them reported activities such as "exploring the world around," "reading more books," "doing more [hand work]," "being more sensitive to people's feelings," "trying to make the subject fun while learning," etc. Some interesting comments on how to connect their learning styles with my class were "by becoming personally involved and influencing the others to work together," "to have a review session or a guide study," and "to gather into groups to think out problems."

I found this activity relevant because we may use Kolb's test to help us identify our strengths and weaknesses as instructors, recognize our students' preferred styles, use teaching techniques to require all learning styles, and encourage our students to extend into other styles. Of particularly interest to me as instructor was to learn the use of the learning cycle to design some of my "lectures." The learning cycle consisted of four questions: why?, what?, how? and what if? (Harb, Durrant, & Terry, 1993.) I tried to emphasize in my lectures the answers to these questions because in that way I could reach most of the different learning styles of my students. This framework opened my eyes to the importance of Kolb's learning styles, and because of its practical applications in teaching, I would like to keep using Kolb learning cycles as part of my other classes I teach for the College of Engineering.

Reference:
Harb, Durrant, & Terry, (1993). Use of the Kolb learning cycle and the 4MAT system in engineering. *Education, Journal of Engineering Education*, 70-77.

Use of Kolb's Inventory of Learning Styles
CITL – IENG 475 Fall 2006
Regina Rahn

The Kolb Learning Style Inventory was administered to students in the Fall 2006 IENG 475 Decision Analysis class. They completed the questionnaire and interpreted their learning styles. We discussed, as a class, the strengths of each learning style and talked about the types of activities that were useful for facilitating learning of each type. The idea was to set a premise for the assessment and instructional activities that would be implemented during the semester.

In addition, we discussed ways that individuals could use the knowledge of their learning styles to expand the ways in which they learn to incorporate other styles. The discussion included the use of group work (cooperative learning) and peer review as ways to aid in accomplishing this goal.

A graduate student used this as one of the bases for her graduate project. The project was completed at the end of the semester. The IENG 475 students were surveyed about their thoughts in regard to the use of the learning style inventory. The responses were extremely positive, and they definitely saw the value in the exercise.

The Decision Analysis class also posed a unique opportunity for discussions surrounding learning styles. We investigated relationships between learning styles and peoples' attitude toward risk, which is a key element in the course subject matter. I intend to continue utilizing learning style inventories in my courses.

Student Learning Outcomes & Bloom & Dale (Fall 2005 and Fall 2006)

The professors analyzed their student learning outcomes against Bloom's Learning Dimensions and Dale's Cone of learning. The analysis of the 2005 course is presented in black below and also as a composite, number of outcomes achieving what level on Bloom's and Dale's models. The 2006 course analysis, however, is presented in red. Dale's levels are presented by number of outcomes and level of the Cone. For Bloom, each outcome is listed at the level achieved. This program component was also successful. The professors really seemed to grasp Bloom's intentions, whether traditional or revised. They not only benefited from using it as an analysis tool, but in the later re-development of their courses. They also grasped Dale's intentions about passive versus active learning. These models seemed to build good initial awareness, which deepened as they used them as tools more and more, beginning with the initial 2005 analysis and then as a metric for the re-development of the 2006 courses. There was significant change in the quality of their student learning outcomes. The professors' student learning outcomes were developed and written to achieve higher cognitive processing levels on Bloom's Cognitive Dimension. T he outcomes also reflective higher quality in that they reflected more active learning. The outcomes reflected a potentially higher level of critical thinking as well. This program component resulted in significant change and left them with simple tools to use as metrics for ongoing change and quality checks.

Table B.11.c.8: Student Learning Outcomes & Bloom & Dale (Fall 2005 and Fall 2006)
(7 professors across engineering and technology)

# Outcomes: **05 reported as composite** **06 reported- specific outcome**	**Dale's Cone Levels : P AA+**	**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**	**Critical Thinking Level:** **L M H**
(1) 6 outcomes composite **1-11 numbers 1-11**	**NR** **1-11** **(8-10) A+**	**1+, 5NR**	**2+, 4NR**	**2+, 4NR**	**1c, 5NR** **1, 3, 7. 8. 9**	**1+, 5NR** **2, 5, 6, 7. 10, 11**	**6NR** **1, 4**	**2Lm 3M, 1H**
(2) 3/6 **5**	**3P, 1A** **2A-** **1-5** **(10) A+**	**6+**	**6+**	**3+, 3c**	**5c, 1NR**	**6c**	**6c** **1-3/6**	**2L, 2L+, 1L/M, 1M; 2Mc**
(3) 2 **2**	**2 PA-C** **1-2** **(8-10) A+**	**2 +c**	**2 +c**	**2+c**	**2 +c**	**2 +c**	**2c** **1, 2**	**2Mc**
(4) 4 **5**	**2A, 2A+** **NR**	**4+** **NR**	**4+** **NR**	**4+** **NR**	**4+** **NR**	**1c, 1+-, 2+** **NR**	**4c** **NR**	**2M, 2H**
(5) 5 **19**	**2P, 2A, 1A+** **1 (6);** **2-3 (9)** **4 (6)** **5-19** **(9-10)A+**	**2+, 3NR** **NR**	**2NR, 3+** **NR**	**2NR, 3+** **NR**	**NR** **NR**	**NR** **NR**	**NR** **NR**	**3M**
(6) 6 **6**	**4P, 2A** **3 (2)** **4 (1,3,5)** **8-9 (1)** **8 (1)**	**2+, 4c**	**3+, 3c** **1, 2, 3, 5**	**5+, 1c**	**4+, 2c**	**5+, 1c** **4**	**4c, 2+** **6**	**3L, 2M, 1H**
(7) 4 **4**	**1P, 1P-A, 2A-P** **1-4 (1-10)**	**4+**	**4+**	**1+c, 3+**	**1c, 1c+, 2+** **1**	**2c, 2+** **2**	**2c, 2+**	**2c, 2c+** **3, 4**

Bloom (1956); Anderson & Krathwohl (2001); Legend for Blooms levels: NR = no response; number + = number of outcomes at that level; +c = okay, but still need to consider; c = need to consider achieving; c+ = some positive accomplishment, but still needs work (**e.g., outcome number reported by each Boom level)**
Dale (1969): Legend for Dale's levels: 9-10 = active learning-doing level; 8 = active learning-participating; 3-7 = visual receiving/passive; 2-1 = verbal receiving-passive,
(e.g., outcome number - level)

CLASSROOM RESEARCH SEMESTER
RESULTS ON THE SCHOLARSHIP OF TEACHING
Jerry Gilmer, Ph.D. and Jule Dee Scarborough, Ph.D.
. (See B.13 for manuscript drafts presenting their individual research results.)

Each faculty member participated in the culminating research semester, where they performed experimental research on teaching and learning. Before that final aspect of The Faculty Development Program on Teaching and Learning, the professors engaged together to

- analyze their courses for quality of disciplinary knowledge content,
- analyze the embedded general education knowledge within the engineering and technology content
- analyze the variety of teaching models and styles used throughout their courses
- analyze the range of student learning styles made possible in the course
- analyze the level of Bloom's Cognitive Process Dimension and Dale's active vs. passive learning achieved by the course and students
- analyze the quality of student assessments, e.g., tests
- analyze the strength of the connections between the national student learning outcomes and the student learning outcomes for the courses
- analyze the strength of the connections between the course content and student assessment(s) and items
- redevelop their 2005 courses and develop new student learning outcomes for the 2006 courses
- develop new tests and performance assessments with rubrics
- develop grading structures and criteria
- select new teaching models and styles to use in the redeveloped 2006 course
- make choices about instructional strategies that broadened the range of possible student learning styles
- **learn about educational or social science experimental, classroom research on teaching and learning**
- **interact with program leaders to design an experimental study on teaching and learning related to what they had learned throughout the faculty development program**
- **perform experimental classroom research with their students**
- **implement new teaching strategies, models, processes, techniques, and more**
- **prepare research manuscripts to submit to professional journals detailing the results of their research**

Therefore, as one program component in the CEET Faculty Development Program on Teaching and Learning, each of the seven professors carried out a formal research project in their classrooms during the Fall 2006 semester, with each research project conforming to the professors' specific areas of interest stemming from the program components in the faculty development program. We consider this a critical aspect of our program. Professors began the program by building a knowledge foundation about teaching and learning; used that knowledge to analyze their courses and develop new ones, including educational products to use with student; and then participated in the culminating experience, where they taught the newly

developed courses using new educational strategies, methods, and procedures as well as new products and engaged in experimental research fir the first time. Some of the projects included comparing cooperative performance-based procedures to individual performance-based procedures, comparing hands-on manipulative procedures to graphical procedures in problem-based learning projects, examining the effects of the *order* of administration of performance assessment and a traditional assessment, and others. See the full range of research questions below followed by the results. All experimental designs are considered true experimental designs, with each involving at least two experimental groups, random assignment of students to each group, and both a pretest and a posttest. Of the seven studies, only one exhibited statistically significant results (cooperative performance-based procedures appeared to result in more learning than individual performance-based procedures).

From the perspective of each research study, the absence of statistical significance may be disappointing to the professors. However, from the perspective of the Initiative**,** the actual completion of these research studies indicates a high level of success. The primary goals of the research component included the professors learning the basics of different educational research designs, the importance of controlling and isolating the effects of variables, some basic concepts of statistical analysis, and ultimately, the implementation by each professor of an actual research project in their own classroom. All of these goals were met in this program. In addition, the professors' learning was enhanced as they evaluated their procedures and methodologies – normal activities for any researcher – and developed hypotheses that could explain the lack of significant results. Finally, we hope that this has begun a program of research on the Scholarship of Teaching in which each professor analyzed his/her research results, considered and explained the results, and then will continue individual programs of research by designing a follow up study with related or different research question on teaching and learning. We also hope that they continue research as a Learning Community, where they collectively interact and engage together to design and execute new studies. The specific research designs along with the basic statistical results are presented below. For specific study results, see results sections below. Please note that two different professors researched the same questions presented in 2 and 4 below. Also another two different professors researched the same questions, presented in 5 and 7 below. The research questions across all Learning Community members were

1. Does individual performance-based learning or cooperative performance-based learning result in better student learning as reflected in an end-of-unit exam?

2. a. Does a performance assessment administered in conjunction with a traditional test result in increased learning beyond the traditional test alone as indicated by scores on the traditional test?

   b. Does the order of the administration of a performance assessment and a traditional test result in differential learning as indicated by the combination of the performance assessment and traditional test scores?

   c. Does the order of administration of a performance assessment and a traditional test affect knowledge retention as indicated by a final exam?

3. a. In problem-based learning projects, are hands-on manipulative procedures more effective on learning than graphical procedures as reflected in a midterm exam?

   b. In problem-based learning projects, are hands-on manipulative procedures more effective on retention of learning than graphical procedures as reflected in a final exam?

4. a. Does a performance assessment administered in conjunction with a traditional test result in increased learning beyond the traditional test alone as indicated by scores on the traditional test?

   b. Does the order of the administration of a performance assessment and a traditional test result in differential learning as indicated by the combination of the performance assessment and traditional test scores?

   c. Does the order of administration of a performance assessment and a traditional test affect knowledge retention as indicated by a final exam?

5. a. Does individual learning vs. cooperative learning result in differential knowledge gains as indicated by a traditional test?

   b. Does individual learning vs. cooperative learning result in differential knowledge retention as indicated by a final exam.

6. a. Does the administration of a performance assessment that covers a subset of content also covered in a traditional midterm result in increased learning beyond the administration of the traditional midterm alone as indicated by the scores on the traditional midterm?

   b. Does the administration of a performance assessment that covers a subset of content also covered in a traditional midterm result in increased knowledge retention beyond the administration of the traditional midterm alone as indicated by a separate final exam?

7. a. Does individual learning vs. cooperative learning result in differential knowledge gains as indicated by a traditional test?

   b. Does individual learning vs. cooperative learning result in differential knowledge retention as indicated by a final exam?

Ibrahim Abdel-Motaleb

Custom Model: Individual Performance-Based Learning vs. Cooperative Performance-Based Learning

The basic research question in this model is:

1. Does individual performance-based learning or cooperative performance-based learning result in better student learning as reflected in an end-of-unit exam (either midterm or final).

Table B.12.1

Research Model: Individual vs. Cooperative Performance-Based Learning

		Treatment	Posttest		Treatment	Posttest
Experimental Group 1	Instruction	Individual Performance-Based	Midterm	Instruction	Cooperative Performance-Based	Final
Experimental Group 2	Instruction	Cooperative Performance-Based	Midterm	Instruction	Individual Performance-Based	Final
	Replication 1			Replication 2		

Students will be randomly assigned to the two experimental groups and, therefore, those groups can be considered equivalent. The experiment will actually be administered twice during the semester. To enhance the fairness to the class both groups will be exposed to both treatment conditions – alternating across the two replications. The final is not a comprehensive final, so there should be no carryover from the midterm to the final that might contaminate the interpretation of the results.

The research question will be addressed by comparing the mean test scores between the two groups for each replication of the experiment.

Ibrahim Abdel-Motaleb – Research Results

During a performance based learning unit the 24 students in the class were assigned to either an individual learning environment or a cooperative learning environment. The midterm exam covered the material taught during the performance based learning unit.

The independent variable in this context is the learning environment, either individual or cooperative. The dependent variable is the score on the midterm exam. The results of the statistical analysis are presented in the table below. The statistical significance level is based on an independent samples t-test.

Table B.12.2

Variable	**Group**	**N**	**Mean**	**SD**	**Sig. Level (df=22)**
1. Midterm	Individual	9	22.4	3.5	**.005**
	Cooperative	15	28.7	6.1	

Research Question:

1. The difference between means for the individual learning environment and the cooperative learning environment from the midterm *was statistically significant* beyond the .05 level of significance.

This statistical significance indicates that a null hypothesis specifying equal effects of individual learning and cooperative learning in this context can be rejected. The cooperative learning environment appears to have produced more learning, based on the midterm exam scores, than the individual learning environment.

[The original design for this experiment specified two replications – one from the midterm and one from the final exam. However, data from the second replication were not submitted for analysis.

Table B.12.3

Group Statistics

	Group Assignment	N	Mean	Std. Deviation	Std. Error Mean
Midterm Score	Individual	9	22.4444	3.53946	1.17982
	Cooperative	15	28.6667	6.16055	1.59065

Table B.12.4

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	**Sig. (2-tailed)**	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Midterm Score	Equal variances assumed	6.369	**.019**	-2.754	22	.012	-6.22222	2.25909	-10.90728	-1.53716
	Equal variances not assumed			-3.142	21.993	**.005**	-6.22222	1.98044	-10.32948	-2.11497

Abul Azad

Performance Assessment and Traditional Test Administered in Different Order

This study is designed to examine the following questions:

1. Does a performance assessment administered in conjunction with a traditional test result in increased learning beyond the traditional test alone as indicated by scores on the traditional test?

2. Does the order of the administration of a performance assessment and a traditional test result in differential learning as indicated by the combination of the performance assessment and traditional test scores?

3. Does the order of administration of a performance assessment and a traditional test affect knowledge retention as indicated by a final exam?

The basic design for this study is presented in the table below.

Table B.12.5

Model 2: Performance Assessment and Traditional Test Administered in Different Order

Group 1	Instruction	Performance Assessment	Traditional Test	----------→	Final
Group 2	Instruction	Traditional Test	Performance Assessment	----------→	Final

Students will be randomly assigned to the experimental and control groups and therefore those groups can be considered equivalent. Group 1 will receive the performance assessment before the traditional test and group 2 will receive the traditional test before the performance assessment.

Question 1 will be addressed by comparing the traditional test means between the two groups.

Question 2 will be addressed by comparing the combined performance assessment and traditional test scores between the two groups.

Question 3 will be addressed by comparing scores from the final that are based on material also covered on the midterm (the performance assessment and the traditional midterm test) between the two groups.

Abul Azad – Research Results

The fifteen students in the class were divided into the two treatment groups; group 1 was comprised of eight students who took the midterm performance assessment followed by the traditional midterm and group 2 was comprised of seven students who took the traditional midterm followed by the performance assessment.

The independent variable in this context is group assignment. The dependent variables depend on the specific research questions addressed. The results of the statistical analysis for each dependent variable are presented in the table below. The statistical significance levels are based on independent samples t-tests.

Table B.12.6

Variable	**Group**	**N**	**Mean**	**SD**	**Sig. Level (df=13)**
1. Traditional Midterm	1. Perf. First	8	91.1	7.3	**.69**
	2. Trad. First	7	92.4	4.4	
2. Combined Traditional Midterm & Performance Assessment	1. Perf. First	8	162.3	33.5	**.55**
	2. Trad. First	7	171.4	23.4	
3. Final Exam – Midterm Content Only	1. Perf. First	8	22.9	13.9	**.16**
	2. Trad. First	7	30.9	3.1	

Research Questions:

1. The difference between group means for variable 1 – the traditional midterm exam, was not statistically significant beyond the .05 level of significance.

2. The difference between the group means for variable 2 – the combined traditional midterm exam and the midterm performance assessment, was not statistically significant.

3. The difference between the group means for variable 3 – the final exam scores for the midterm content, was not statistically significant.

Although, for all three variables, the mean for students taking the traditional midterm first were higher than the mean for students taking the performance test first, none of the mean differences was statistically significant. This lack of statistical significance indicates that a null hypothesis specifying equal effects of treatment groups in this context is still a viable hypothesis and cannot be rejected. Some possible technical reasons for this result could relate to the small sample sizes and, in some cases, the relatively large standard deviations, both of which can be related to non-significant results. There are also possible classroom context and operational factors which could be related to the results. These factors should be considered and discussed by the experimenter.

Technical note: Although some of the group variances above are clearly not equal within each variable, SPSS performs the analyses based on both equal and non-equal group variances. In either case, the differences between means were not significant.

Table B.12.7

Group Statistics

	Group Assignment	N	Mean	Std. Deviation	Std. Error Mean
Midterm Traditional Assessment	Performance First	8	91.1250	7.25923	2.56653
	Traditional First	7	92.4286	4.42934	1.67413
Combined Trad & PA	Performance First	8	162.2500	33.47387	11.83480
	Traditional First	7	171.4286	23.35135	8.82598
Final on Midterm Content	Performance First	8	22.8750	13.93287	4.92602
	Traditional First	7	30.8571	3.13202	1.18379
	Traditional First	7	79.0000	24.27619	9.17554

Table B.12.8

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	**Sig. (2-tailed)**	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Midterm Traditional Assessment	Equal variances assumed	1.058	.322	-.412	13	**.687**	-1.30357	3.16637	-8.14409	5.53695
	Equal variances not assumed			-.425	11.744	.678	-1.30357	3.06427	-7.99625	5.38910
Combined Trad & PA	Equal variances assumed	3.346	.090	-.607	13	**.555**	-9.17857	15.13348	-41.87247	23.51533
	Equal variances not assumed			-.622	12.456	.545	-9.17857	14.76348	-41.21521	22.85807
Final on Midterm Content	Equal variances assumed	8.352	**.013**	-1.477	13	.164	-7.98214	5.40477	-19.65843	3.69415
	Equal variances not assumed			-1.576	7.802	**.155**	-7.98214	5.06626	-19.71690	3.75262

Brianno Coller

Model 1: Hands-On Manipulative Procedures vs. Graphical Procedures

This study is designed to examine two questions:

1. In problem-based-learning projects, are hands-on manipulative procedures more effective on learning than graphical procedures as reflected in a midterm exam?

2. In problem-based-learning projects, are hands-on manipulative procedures more effective on retention of learning than graphical procedures as reflected in a final exam?

Table B.12.9

Model 1: Hands-On Manipulative vs. Graphical

		Treatment	Posttest 1		Posttest 2
Experimental Group 1	Instruction	Hands-On Manipulative	Midterm	----------→	Final
Experimental Group 2	Instruction	Graphical	Midterm	----------→	Final

Students will be randomly assigned to the two experimental groups and, therefore, those groups can be considered equivalent. Each group will be given some problem-based learning tasks; group 1 will attempt to resolve/complete the tasks with hands-on manipulation of physical objects, while group 2 will attempt to resolve/complete the problems with graphical techniques. After the administration of the midterm (posttest 1), the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

Question 1 will be addressed by comparing the posttest 1 means between the two groups. Question 2 will be addressed by comparing the posttest 2 means between the groups and by comparing the posttest 1 means to the posttest 2 means (for the items in the final that cover material in the midterm) across the two groups.

Brianno Coller – Research Results

Sixty-four students in the class were assigned to either Group 1 using a Hands-On Manipulative procedure or to Group 2 using a Graphical procedure while working on problem-based learning projects. All students were given a midterm exam on concepts covered; the final exam also covered some of the same concepts covered by the midterm.

The independent variable in this context is group assignment, either hands-on manipulative or graphical. The dependent variable is either the midterm score or the score on the portion of the final covering midterm content, depending on the research question. The results of the statistical analysis are presented in the table below. The statistical significance level is based on independent samples t-tests.

Table B.12.10

Variable	**Group**	**N**	**Mean**	**SD**	**Sig. Level (df=62)**
1. Midterm	Hands On Manipulative	30	19.6	5.4	**.96**
	Graphical	34	19.7	5.5	
2. Final Exam – Midterm Content Only	Hands On Manipulative	30	63.2	16.6	**.77**
	Graphical	34	64.6	20.9	

Research Questions:

1. The difference between means for the hands-on manipulative group and the graphical group for the midterm was not statistically significant beyond the .05 level of significance.

2. The difference between means for the hands-on manipulative group and the graphical group for the final exam content that was also covered on the midterm was not statistically significant beyond the .05 level of significance.

This lack of statistical significance indicates that a null hypothesis specifying equal effects of hands-on manipulative and graphical procedures in this context is still a viable hypothesis and cannot be rejected. Some possible reasons for this result could be related to classroom context and operational factors. These factors should be considered and discussed by the experimenter.

Brianno Coller – SPSS Output

Table B.12.11

Group Statistics

	Group Assignment	N	Mean	Std. Deviation	Std. Error Mean
Midterm	Hands-On Manipulative	30	19.60	5.437	.993
	Graphical	34	19.68	5.465	.937
Final - MT Content (Zeros Deleted)	Hands-On Manipulative	30	63.23	16.565	3.024
	Graphical	34	64.65	20.875	3.580

Table B.12.12

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	**Sig. (2-tailed)**	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Midterm	Equal variances assumed	.128	.721	-.056	62	**.956**	-.076	1.366	-2.806	2.653
	Equal variances not assumed			-.056	61.088	.956	-.076	1.365	-2.806	2.653
Final - MT Content (Zeros Deleted)	Equal variances assumed	1.148	.288	-.297	62	**.767**	-1.414	4.755	-10.918	8.090
	Equal variances not assumed			-.302	61.352	.764	-1.414	4.686	-10.784	7.956

Abhijit Gupta

Performance Assessment and Traditional Test Administered in Different Order

This study is designed to examine the following questions:

1. Does a performance assessment administered in conjunction with a traditional test result in increased learning beyond the traditional test alone as indicated by scores on the traditional test?

2. Does the order of the administration of a performance assessment and a traditional test result in differential learning as indicated by the combination of the performance assessment and traditional test scores?

3. Does the order of administration of a performance assessment and a traditional test affect knowledge retention as indicated by a final exam?

The basic design for this study is presented in the table below.

Table B.12.13

Model 2: Performance Assessment and Traditional Assessment Administered in Different Order

Group 1	Instruction	Performance Assessment	Traditional Test	----------→	Final
Group 2	Instruction	Traditional Test	Performance Assessment	----------→	Final

Students will be randomly assigned to the experimental and control groups and therefore those groups can be considered equivalent. Group 1 will receive the Performance assessment before the traditional test and group 2 will receive the traditional test before the Performance assessment.

Question 1 will be addressed by comparing the traditional test means between the two groups.

Question 2 will be addressed by comparing the combined performance assessment and traditional test scores between the two groups.

Question 3 will be addressed by comparing scores from the final that are based on material also covered on the midterm (the performance assessment and the traditional midterm test) between the two groups.

The 44 students in the class were divided into the two treatment groups: group 1 was comprised of 22 students who took the midterm performance assessment followed by the traditional midterm, and group 2 was comprised of 22 students who took the traditional midterm followed by the performance assessment.

The independent variable in this context is group assignment. The dependent variables depend on the specific research questions addressed. The results of the statistical analysis for each dependent variable are presented in the table below. The statistical significance levels are based on independent samples t-tests.

Table B.12.14

Variable	**Group**	**N**	**Mean**	**SD**	**Sig. Level (df=42)**
1. Traditional Midterm	1. Perf. First	22	41.0	8.9	**.97**
	2. Trad. First	22	41.2	14.2	
2. Combined Traditional Midterm & Performance Assessment	1. Perf. First	22	66.8	9.8	**.53**
	2. Trad. First	22	69.1	14.4	
3. Final Exam – Midterm Content Only	1. Perf. First	22	25.7	6.4	**.13**
	2. Trad. First	22	29.0	7.8	

Research Questions:

1. The difference between group means for variable 1 – the traditional midterm exam, was not statistically significant beyond the .05 level of significance.

2. The difference between the group means for variable 2 – the combined traditional midterm exam and the midterm performance assessment, was not statistically significant.

3. The difference between the group means for variable 3 – the final exam scores for the midterm content, was not statistically significant.

Although, for all three variables, the mean for students taking the traditional midterm first were higher than the mean for students taking the performance test first, none of the mean differences was statistically significant. This lack of statistical significance indicates that a null hypothesis specifying equal effects of treatment groups in this context is still a viable hypothesis and cannot be rejected. Some possible reasons for this result could be related to classroom context and operational factors. These factors should be considered and discussed by the experimenter.

Technical note: Although some of the group variances above are clearly not equal within each variable, SPSS performs the analyses based on both equal and non-equal group variances. In either case, the differences between means were not significant.

Abhijit Gupta – SPSS Output

Table B.12.15

Group Statistics

	Group Assignment	N	Mean	Std. Deviation	Std. Error Mean
Midterm Traditional Assessment	Performance First	22	41.0455	8.93083	1.90406
	Traditional First	22	41.1818	14.22820	3.03346
Combined Trad & PA	Performance First	22	66.7727	9.76355	2.08160
	Traditional First	22	69.1364	14.40666	3.07151
Final on Midterm Content	Performance First	22	25.6818	6.42455	1.36972
	Traditional First	22	29.0000	7.84978	1.67358

Table B.12.16

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	**Sig. (2-tailed)**	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Midterm Traditional Assessment	Equal variances assumed	2.323	.135	-.038	42	**.970**	-.13636	3.58153	-7.36418	7.09145
	Equal variances not assumed			-.038	35.32	.970	-.13636	3.58153	-7.40487	7.13214
Combined Trad & PA	Equal variances assumed	1.293	.262	-.637	42	**.528**	-2.36364	3.71042	-9.85157	5.12429
	Equal variances not assumed			-.637	36.93	.528	-2.36364	3.71042	-9.88214	5.15487
Final on Midterm Content	Equal variances assumed	1.653	.206	-1.534	42	**.132**	-3.31818	2.16264	-7.68256	1.04620
	Equal variances not assumed			-1.534	40.42	.133	-3.31818	2.16264	-7.68762	1.05126

Reinaldo Moraga

Model 4 – Individual Learning vs. Cooperative Learning

This study is designed to examine the following questions:

1. Does individual learning vs. cooperative learning result in differential knowledge gains as indicated by a traditional test?

2. Does individual learning vs. cooperative learning result in differential knowledge retention as indicated by a final exam?

The design for this study is presented in the table below.

Table B.12.17

Model 4: Individual Learning vs. Cooperative Learning

	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Traditional Test	----------→	Final
Cooperative Learning Group	Cooperative Learning	Traditional Test	----------→	Final

Treatment				
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Individual	Cooperative	Individual	Cooperative
2	Cooperative	Individual	Cooperative	Individual

Random assignment of students to two groups will allow us to assume the groups are equivalent. The actual delivery of the treatment conditions will alternate across content areas and groups, as shown in the blowout diagram; group 1 will be the individual learning group for content areas I & III, while group 2 will be the individual learning group for content areas II & IV. This will add to the validity of the design and enhance the fairness of the treatment conditions within the student groups. For this delivery model to work there needs to be an even number of content areas with a minimum of two. For fairness to students, each content area should also be weighted approximately equally within both posttests. After the administration of the Traditional Test (Posttest 1) the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

Question 1 will be addressed by comparing the posttest 1 means under the individual and cooperative learning conditions. Question 2 will be addressed with similar comparisons on the posttest 2 means.

The 18 students in the class were assigned to either Group 1 or to Group 2, with 9 students in each group. Then four different areas of content were taught to all 18 students. For content area I students in group 1 worked individually and students in group 2 worked cooperatively (in small groups). For content area II, the individual and cooperative approach was reversed between the two groups. This was repeated, with the reversals, for content areas III and IV. The content was covered on the midterm and some of the same content was covered on the final. Thus for both the midterm and final, each student obtained a score for content he or she learned on an individual basis and a score for content he or she learned on a cooperative basis.

The independent variable in this context is learning environment, either individual or cooperative. For research question 1 the dependent variable is the score on the midterm exam that matches individual or cooperative learning: that is, a student obtained an individual-learning score based on the midterm content that the student learned while working in the individual learning environment and the student also obtained a cooperative-learning score based on the midterm content that the student learned while working in the cooperative learning environment. For research question 2, the dependent variable is the score on the final exam that matches individual or cooperative learning for the content on the final that was also covered on the midterm. The results of the statistical analysis for each dependent variable are presented in the table below. The statistical significance levels are based on paired samples t-tests.

Table B.12.18

Variable	**Group**	**N**	**Mean**	**SD**	**Sig. Level (df=17)**
1. Midterm	Individual	18	29.1	8.0	**.08**
	Cooperative	18	25.8	9.1	
2. Final Exam – Midterm Content Only	Individual	18	3.4	1.4	**.71**
	Cooperative	18	3.3	1.7	

Research Questions:

1. The difference between means for the individual learning environment and the cooperative learning environment for the midterm was not statistically significant beyond the .05 level of significance.

2. The difference between means for the individual learning environment and the cooperative learning environment for the final exam content that was also covered on the midterm was not statistically significant beyond the .05 level of significance.

This lack of statistical significance indicates that a null hypothesis specifying equal effects of individual learning and cooperative learning in this context is still a viable hypothesis and cannot be rejected. Some possible reasons for this result could be related to classroom context and operational factors. These factors should be considered and discussed by the experimenter.

Table B.12.19

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Midterm Individual	29.1111	18	7.97709	1.88022
	Midterm Cooperative	25.7778	18	9.12370	2.15048
Pair 2	Final MT Content Individual	3.4444	18	1.38148	.32562
	Final MT Content Cooperative	3.3333	18	1.68034	.39606

Table B.12.20

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Midterm Individual & Midterm Cooperative	18	.605	.008
Pair 2	Final MT Content Individual & Final MT Content Cooperative	18	.693	.001

Table B.12.21

Paired Samples Test

		Paired Differences					t	df	**Sig. (2-tailed)**
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Midterm Individual - Midterm Cooperative	3.33333	7.66965	1.80775	-.48069	7.14736	1.844	17	**.083**
Pair 2	Final MT Content Individual - Final MT Content Cooperative	.11111	1.23140	.29024	-.50125	.72347	.383	17	**.707**

Regina Rahn

Model 1 –Traditional Test With Performance Assessment

This study is designed to examine the following questions:

1. Does the administration of a performance assessment that covers a subset of content also covered in a traditional midterm result in increased learning beyond the administration of the traditional midterm alone as indicated by the scores on the traditional midterm?

2. Does the administration of a performance assessment that covers a subset of content also covered in a traditional midterm result in increased knowledge retention beyond the administration of the traditional midterm alone as indicated by a separate final exam?

The basic design for this study is presented in the table below.

Table B.12.22

Model 1: Traditional Test With Performance Assessment

		Treatment	Posttest 1		Posttest 2
Experimental Group	Instruction	Performance Assessment Related to Traditional Test	Traditional Midterm	----------→	Traditional Final
Control Group	Instruction	Performance Assessment Not Related to Traditional Test (Placebo)	Traditional Midterm	----------→	Traditional Final

Students will be randomly assigned to the experimental and control groups and therefore those groups can be considered equivalent. The treatment for the experimental group is essentially the administration of the traditional midterm along with some performance assessment activities covering some of the same content that is covered in the traditional midterm. The treatment for the control group is the administration of the traditional midterm and a placebo – perhaps some performance assessment activities that are not related to the content in the traditional midterm. After the administration of the Traditional Test (Posttest 1), the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

Question 1 will be addressed by comparing the traditional midterm means across the experimental and control groups. Question 2 will be addressed by comparing the final exam means across the experimental and control groups (for the content in the final that is also in the midterm) across the two groups.

Regina Rahn – Research Results

The 14 students in the class were assigned to either Group1, the Decision Tree environment, or to Group 2, the Fault Tree environment. The independent variable in this context is learning environment, either decision tree or fault tree. The dependent variable is the score on the midterm for research question 1 and the score on the portion of the final exam over material that was covered on the midterm for research question 2.

The results of the statistical analysis for each dependent variable are presented in the table below. The statistical significance levels are based on independent samples t-tests.

Table B.12.23

Variable	**Group**	**N**	**Mean**	**SD**	**Sig. Level (df=12)**
1. Midterm	Decision Tree Fault Tree	7 7	74.7 79.7	7.6 8.8	**.27**
2. Final Exam – Midterm Content Only	Decision Tree Fault Tree	7 7	25.1 22.4	4.1 3.0	**.19**

Research Questions:

1. The difference between means for the decision tree environment and the fault tree environment for the midterm was not statistically significant beyond the .05 level of significance.

2. The difference between means for the decision tree environment and the fault tree environment for the final exam content that was also covered on the midterm was not statistically significant beyond the .05 level of significance.

This lack of statistical significance indicates that a null hypothesis specifying equal effects of decision tree and fault tree learning environments in this context is still a viable hypothesis and cannot be rejected. Some possible reasons for this result could be related to classroom context and operational factors. These factors should be considered and discussed by the experimenter.

Regina Rahn – SPSS Output

Table B.12.24

Group Statistics

	Group Assignment	N	Mean	Std. Deviation	Std. Error Mean
Midterm DT Content	DT Group	7	18.2857	3.54562	1.34012
	FT Group	7	16.8571	4.52506	1.71031
Midterm Total	DT Group	7	74.7143	7.56559	2.85952
	FT Group	7	79.7143	8.82637	3.33605
Final DT Content	DT Group	7	25.1429	4.09994	1.54963
	FT Group	7	22.4286	3.04725	1.15175
Final FT Content	DT Group	7	35.7143	2.98408	1.12788
	FT Group	7	38.4286	2.43975	.92214
Final Total	DT Group	7	84.0000	7.83156	2.96005
	FT Group	7	81.2857	7.65320	2.89264

Table B.12.25

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Midterm DT Content	Equal variances assumed	1.938	.189	.657	12	**.523**	1.42857	2.17281	-3.30557	6.16271
	Equal variances not assumed			.657	11.351	.524	1.42857	2.17281	-3.33578	6.19293
Midterm Total	Equal variances assumed	.607	.451	-1.138	12	**.277**	-5.00000	4.39387	-14.57343	4.57343
	Equal variances not assumed			-1.138	11.726	.278	-5.00000	4.39387	-14.59832	4.59832
Final DT Content	Equal variances assumed	2.024	.180	1.406	12	**.185**	2.71429	1.93077	-1.49251	6.92108
	Equal variances not assumed			1.406	11.079	.187	2.71429	1.93077	-1.53163	6.96020
Final FT Content	Equal variances assumed	1.320	.273	-1.863	12	**.087**	-2.71429	1.45686	-5.88852	.45995
	Equal variances not assumed			-1.863	11.544	.088	-2.71429	1.45686	-5.90247	.47390
Final Total	Equal variances assumed	.017	.897	.656	12	**.524**	2.71429	4.13875	-6.30328	11.73185
	Equal variances not assumed			.656	11.994	.524	2.71429	4.13875	-6.30381	11.73238

Robert Tatara

Model 4 – Individual Learning vs. Cooperative Learning

This study is designed to examine the following questions:

1. Does individual learning vs. cooperative learning result in differential knowledge gains as indicated by a traditional test?

2. Does individual learning vs. cooperative learning result in differential knowledge retention as indicated by a final exam?

The design for this study is presented in the table below.

Table B.12.26

Model 4: Individual Learning vs. Cooperative Learning

	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Traditional Test	----------→	Final
Cooperative Learning Group	Cooperative Learning	Traditional Test	----------→	Final

Treatment				
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Individual	Cooperative	Individual	Cooperative
2	Cooperative	Individual	Cooperative	Individual

Random assignment of students to two groups will allow us to assume the groups are equivalent. The actual delivery of the treatment conditions will alternate across content areas and groups, as shown in the blowout diagram. Group 1 will be the individual learning group for content areas I & III, while group 2 will be the individual learning group for content areas II & IV. This will add to the validity of the design and enhance the fairness of the treatment conditions within the student groups. For this delivery model to work there needs to be an even number of content areas with a minimum of two. For fairness to students, each content area should also be weighted approximately equally within both posttests. After the administration of the Traditional Test (Posttest 1) the distinction between the groups is dissolved with instruction and assessment activities delivered to all students equally.

Question 1 will be addressed by comparing the posttest 1 means under the individual and cooperative learning conditions. Question 2 will be addressed with similar comparisons on the posttest 2 means.

The 28 students in the class were assigned to either Group 1 or to Group 2, with 14 students in each group. Then four different areas of content were taught to all 28 students. For content area I students in group 1 worked individually and students in group 2 worked cooperatively (in small groups). For content area II, the individual and cooperative approach was reversed between the two groups. This was repeated, with the reversals, for content areas III and IV. The content was covered on the midterm and some of the same content was covered on the final. Thus for both the midterm and final each student obtained a score for content he or she learned on an individual basis and a score for content he or she learned on a cooperative basis.

The independent variable in this context is learning environment, either individual or cooperative. For research question 1, the dependent variable is the score on the midterm exam that matches individual or cooperative learning. That is, a student obtained an individual-learning score based on the midterm content that the student learned while working in the individual learning environment and the student also obtained a cooperative-learning score based on the midterm content that the student learned while working in the cooperative learning environment. For research question 2, the dependent variable is the score on the final exam that matches individual or cooperative learning for the content on the final that was also covered on the midterm. The results of the statistical analysis for each dependent variable are presented in the table below. The statistical significance levels are based on paired samples t-tests.

Table B.12.27

<table>
<tr><th>Variable</th><th>Group</th><th>N</th><th>Mean</th><th>SD</th><th>Sig. Level
(df=27)</th></tr>
<tr><td rowspan="2">1. Midterm</td><td>Individual</td><td>28</td><td>4.4</td><td>1.3</td><td rowspan="2">.32</td></tr>
<tr><td>Cooperative</td><td>28</td><td>4.1</td><td>1.3</td></tr>
<tr><td rowspan="2">2. Final Exam – Midterm Content Only</td><td>Individual</td><td>28</td><td>3.3</td><td>0.9</td><td rowspan="2">.55</td></tr>
<tr><td>Cooperative</td><td>28</td><td>3.4</td><td>0.9</td></tr>
</table>

Research Questions:

1. The difference between means for the individual learning environment and the cooperative learning environment for the midterm was not statistically significant beyond the .05 level of significance.

2. The difference between means for the individual learning environment and the cooperative learning environment for the final exam content that was also covered on the midterm was not statistically significant beyond the .05 level of significance.

This lack of statistical significance indicates that a null hypothesis specifying equal effects of individual learning and cooperative learning in this context is still a viable hypothesis and cannot be rejected. Some possible reasons for this result could be related to classroom context and operational factors. These factors should be considered and discussed by the experimenter.

Robert Tatara – SPSS Output

Table B.12.28

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Midterm Individual	4.3929	28	1.28638	.24310
	Midterm Cooperative	4.1429	28	1.32537	.25047
Pair 2	Final MT Content Individual	3.2857	28	.93718	.17711
	Final MT Content Cooperative	3.4286	28	.92009	.17388

Table B.12.29

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Midterm Individual & Midterm Cooperative	28	.509	.006
Pair 2	Final MT Content Individual & Final MT Content Cooperative	28	.110	.576

Table B.12.30

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Midterm Individual - Midterm Cooperative	.25000	1.29458	.24465	-.25198	.75198	1.022	27	**.316**
Pair 2	Final MT Content Individual - Final MT Content Cooperative	-.14286	1.23871	.23409	-.62318	.33746	-.610	27	**.547**

RESEARCH MANUSCRIPTS REVIEW AND SUMMARY
Jule Dee Scarborough, Ph.D.
(See Portfolio Sections A.3 Research, A.5 Faculty Development Program, and B.11-12)

Each of the seven professors performed classroom research on the Scholarship of Teaching. For details about their research design and results, see B.11, a-g.

The Scholarship of Teaching, or experimental classroom research, was a variable in the research and evaluation design to determine the success of the CEET Faculty Development Program (A.5). It is important to remember that our primary goal was to prepare the professors for experimental classroom research on teaching and learning. That type of research is quite different from research typically performed by engineers and technologists. The research was based upon what they learned in the Faculty Development Program about teaching and student learning, including the program component on educational research. Based upon their interests, stemming from program participation, the professors worked with the program leaders to determine research questions and the experimental study designs. They then executed the research in their respective classrooms.

Only one study achieved statistical significance in student learning; the others did not achieve statistical significance. However, our primary goals were to engage them in a program during which they built a knowledge foundation about teaching, student learning and assessment and to prepare them to engage in classroom research on the Scholarship of Teaching. To some, the lack of statistical significance in the classroom research would be disappointing. To us, the formal execution of the research was the primary and most important aspect of the research. As mentioned above, the design and execution of formal experimental research in the classrooms with students as the Scholarship of Teaching was the goal, serving as a variable in the research and evaluation design. Also research studies inform us, regardless of the statistical results. It is important that the professors learn how to explain not only what happens when statistical significance is achieved but also to consider and understand why statistical significance was not achieved. This is what leads to new questions or hypotheses. Either way, the research and its results will inform the teaching and learning communities and contribute to those bodies of knowledge and the literature.

We were pleased with the professors' efforts; their dedication to full execution of formal, experimental classroom research; and their follow through with preparing the draft research manuscripts that will be submitted to professional journals across engineering and technology. All seven professors who participated in the program described in Portfolio Section A.5 and research described in Section A. 3 submitted draft manuscripts. A critique of the manuscripts follows the Faculty Learning Community's research questions below. Please note that two different professors researched the same questions presented in 2 and 4 below. Also another two different professors researched the same questions, presented in 5 and 7 below. The research questions across all Learning Community members were

1. Does individual performance-based learning or cooperative performance-based learning result in better student learning as reflected in an end-of-unit exam.

2. a. Does a performance assessment administered in conjunction with a traditional test result in increased learning beyond the traditional test alone as indicated by scores on the traditional test?

   b. Does the order of the administration of a performance assessment and a traditional test result in differential learning as indicated by the combination of the performance assessment and traditional test scores?

   c. Does the order of administration of a performance assessment and a traditional test affect knowledge retention as indicated by a final exam?

3. a. In problem-based learning projects, are hands-on manipulative procedures more effective on learning than graphical procedures as reflected in a midterm exam?

   b. In problem-based learning projects, are hands-on manipulative procedures more effective on retention of learning than graphical procedures as reflected in a final exam?

4. a. Does a performance assessment administered in conjunction with a traditional test result in increased learning beyond the traditional test alone as indicated by scores on the traditional test?

   b. Does the order of the administration of a performance assessment and a traditional test result in differential learning as indicated by the combination of the performance assessment and traditional test scores?

   c. Does the order of administration of a performance assessment and a traditional test affect knowledge retention as indicated by a final exam?

5. a. Does individual learning vs. cooperative learning result in differential knowledge gains as indicated by a traditional test?

   b. Does individual learning vs. cooperative learning result in differential knowledge retention as indicated by a final exam.

6. a. Does the administration of a performance assessment that covers a subset of content also covered in a traditional midterm result in increased learning beyond the administration of the traditional midterm alone as indicated by the scores on the traditional midterm?

   b. Does the administration of a performance assessment that covers a subset of content also covered in a traditional midterm result in increased knowledge retention beyond the administration of the traditional midterm alone as indicated by a separate final exam?

7. a. Does individual learning vs. cooperative learning result in differential knowledge gains as indicated by a traditional test?

   b. Does individual learning vs. cooperative learning result in differential knowledge retention as indicated by a final exam?

Discussion of Research Manuscripts

Variable to determine success of the CEET Faculty Development Program
As the final evaluation factor to determine or confirm what professors had learned in the CEET Faculty Development Program, the manuscripts revealed that they had learned what was expected. Although *some* of the drafts did not reveal the literature basis or learning theory basis for the research, it was clear in the execution of the studies that they understood what they were trying to achieve. Also some of the professors did not use the educational terminology at all; some used it quite well; some still interchanged terms such as "objectives" with "outcomes." However, once again, it was apparent that they understood what they were discussing. The educational "jargon" or terminology is usually confusing to those who have not followed its transitions and often subtle definition changes with those transitions. Overall, the manuscripts, along with the other eight variables, were evidence of program success.

Quality
The quality of the manuscripts varied from

- excellent, ready to submit for publication
- excellent, appropriate draft; almost ready to submit
- appropriate for draft; consider critique comments, modify, and then submit

Challenges
The greatest challenges to manuscript preparation for these professors seem to be

- use of educational terminology (for all)
- writing style (for some)
- establishing the context of the study within the framework of the learning theory; other research, and relevant literature (for all)
- discussing and interpreting the results in the context of learning theory, other research, and relevant literature (for all)
- establishing where the research leads them next (for all)
- explaining and sourcing the context of their study within the Faculty Development Program (for all, however, some did mention it)
- **Closing the Loop:** none of the professors described changes or future

Some of the professors prepared their manuscripts using a writing style more appropriate for technical or lab reports – no context. Although a few did somewhat, most did not use appropriate educational terminology; however, it is important to remember that most the educational terminology was very new to almost all of the professors. Some professors did not provide the theoretical basis for their research using other research and literature to create the research context and framework; others introduced their research using relevant sources, research or literature, although somewhat minimally, but did not follow through with using it in the results, discussion, analysis, or conclusions sections of their manuscripts. Most importantly, none of the professors described where the research would lead them; they did not **close the loop** and describe what changes they would make in their courses or what research questions would be considered for the future.

Comments are very general and not meant to serve as similar to the Peer Review or Refereed process by journal boards. Our priority was on establishing the overall quality of research, or should the professors choose, also implementation of new teaching and learning strategies. Six articles focused on the research; one, however, focused on teaching and learning – implementation. Therefore, it was not possible to review the research process used by that professor, only the student learning data as reported in Section B.11. See the comments below for each manuscript:

! = excellent   **√** = appropriate first draft
NC = needs more consideration

Table B.12.1: Research Manuscript Review

Professor		**Manuscript Title**		**Quality**					
			Research Questions	**Design**	**Methods**	**Procedures**	**Literature**	**Discussion & Interpretation**	**Conclusions and Recommendations**
Coller, Brianno Mechanical Engineering	! √	*An experiment in hands-on learning in engineering mechanics: statics*	Yes	Yes	Yes	Yes	Yes	Yes	1. Consider writing a manuscript this well describing the program. 2. Use more education and learning terminology **3. Close the Loop:** Also where are you going from here? What changes will this lead you to make in the course next time? Does this lead you to reconsider the design and research again, or on to other research questions? New hypotheses?
Gupta, Abhijit Mechanical Engineering	! √	*Effect of order of administration of Performance Assessment and Traditional Assessment*	Yes	Yes	Yes	Yes	Introduction good; could choose to expand, revealing more literature context for your study	Needs more discussion and interpretation in context with current or related research; if none, then establish that there seems to be no other studies similar to this one	1. Introduce more learning theory; theoretical basis for study 2. Introduce program 3. Use more education and learning terminology 4. Could reference literature in consideration of discussion about results; whether that means adding a "discussion and interpretation" section before results and conclusions??? 5. That would enhance the overall effect of what you are presenting. And there is really a lot more to discuss. **6. Close the Loop:** Also where are you going from here? What changes will this lead you to make in the course next time? Does this lead you to reconsider the design and research again, or on to other research questions? New hypotheses? 7. edit for infinitives 8. use listing and numbers (e.g., research questions, indent and number) 9. check organization and structure

! = excellent √ = appropriate first draft
NC = needs more consideration

Table B. 12. 2: Research Manuscript Review

Professor		Manuscript Title		Quality					
			Research Questions	**Design**	**Methods**	**Procedures**	**Literature**	**Discussion & Interpretation**	**Conclusions and Recommendations**
Regina D. Rahn and Reinaldo J. Moraga Industrial Engineering	! √	*The Study of Knowledge Retention and Increased Learning Through the Use of Performance Based Tasks*	Yes	Yes	Yes	Yes	Introduction good; could choose to expand, but also not necessary	Needs more discussion and interpretation in context with current or related research; if none, then establish that there seems to be no other studies similar to this one	1. Introduce more learning theory; theoretical basis for study 2. Use more education and learning terminology 3. Explain program 4. Could reference literature in consideration of discussion about results; whether that means adding a “discussion and interpretation” section before results and conclusions??? 5. That would enhance the overall effect of what you are presenting. And there is really a lot more to discuss; **6. Close the Loop:** Also where are you going from here? What changes will this lead you to make in the course next time? Does this lead you to reconsider the design and research again or on to other research questions? New hypotheses?
Reinaldo Moraga and Regina Rahn Industrial Engineering	! √	*Studying Knowledge Retention through Cooperative Learning in an Operations Research Course*						Must source literature (e.g., into paragraph- coop learning is well known in literature); have to source these type of statements and mention exactly “what” about coop learning; You did that later, so just source up front;	1. Introduce more learning theory; theoretical basis for study 2. Use more education and learning terminology 3. Explain program 4. Could reference literature in consideration of discussion about results; whether that means adding a “discussion and interpretation” section before results and conclusions??? 5. That would enhance the overall effect of what you are presenting. And there is really a lot more to discuss. **6. Close the Loop:** Also where are you going from here? What changes will this lead you to make in the course next time? Does this lead you to reconsider the design and research again or on to other research questions? New hypotheses?

! = excellent   √ = appropriate first draft
NC = needs more consideration

Table B.12.3: Research Manuscript Review

Professor		Manuscript Title		Quality					
			Research Questions	**Design**	**Methods**	**Procedures**	**Literature**	**Discussion & Interpretation**	**Conclusions and Recommendations**
R. A. Tatara, PhD Technology	√ **NC**	*Applying Detailed Student Learning Objectives, Group Learning, and Assessments in an Introductory Polymers Course*	Not mentioned in manuscript	Yes	Not clear in manuscript; number or separate linearly; Introduce study; set it up with other research and literature context; Identify what you are going to do clearly; Present methodology and procedures;	Not clear in manuscript; number, separate	Some used; but some critical sources not there; need more, especially theoretical basis;	So much more possible in context with literature; Good stage setting for course change from professor centered to student centered; remember knowledge and assessment centered complete the balance; show clear connections to national standards IMPORTANT The "reversed" and "intentional" process is: a. outcomes b. assessments c. teaching models, etc.; see page 3 bottom	1. Background introduces the college and program context; add Introduction to the study 2. use more education and learning terminology 3. need literature to set study context 4.**Introduce more learning theory; theoretical basis for study; add literature to interpret study results 5. break away somewhat from lab report type writing to research manuscript style 6. add abstract and key descriptors; .consider overall organization and structure 7. be clear about: "student learning outcomes," NAIT national standards (whereas ABET has labeled theirs "outcomes," we began with term objectives because that was traditional language and the way some had it in their course, as course learning objectives, etc.) 8. be more specific about change process; that will impress readers and help them to understand magnitude of change 9. must source (e.g., individual vs. group learning accountability, Johnson, etc.) 10. source program, etc. 11. In intro, add intro to CEET program, etc.; that is the context of the study 12. results are good, but what does this mean for the course and other courses? Is replication needed? Close the loop; identify changes for next time teaching course 13. change fonts and size in graphics or boxes-reader impact 14. Conclusions must be addressed related to theory and other studies or research; connect and discuss, then interpret, then conclude 15. **Close the Loop:** Also where are you going from here? What changes will this lead you to make in the course next time? Does this lead you to reconsider the design and research again or on to other research questions? New hypotheses?

! = excellent **√** = appropriate first draft
NC = needs more consideration

Table B.12.4: Research Manuscript Review

Professor		Manuscript Title		Quality					
			Research Questions	**Design**	**Methods**	**Procedures**	**Literature**	**Discussion & Interpretation**	**Conclusions and Recommendations**
Azad, Abul Engineering Technology	! √ NC	Suggest new titles to better reflect manuscript content Re-design of an Introductory Digital Electronics within an Electrical Engineering Technology Undergraduate Program Reflective Practice – Part I: Course Re-design in Engineering and Technology Using Educational Theory, Research, Best Practices: Part I The Scholarship of Teaching Through Reflective Practice – Part II: Experimental Classroom Research in Engineering and Technology	NA **Implementation and Program manuscript** Appropriate approach: Program description and outcomes was focus, not classroom research; Resesarch article will be prepared as second manuscript	Ok for type of article Appendixes – good approach for presenting products	NA for research, but for presenting program process, ok	NA for research, but for presenting program process, ok	You have some good sourcing, but can use more literature throughout	Expand this section and use literature to discuss as similar, dissimilar, or how we have gone in a new direction	1. The priority of the manuscripts was to prepare a manuscript about the classroom research as that is the primary focus of the initiative. 2. Consider using more sources in the Intentional Instructional Design section. Use Wiggins for Reversed Design, Dick and Carey for Systematic Design, Jule Scarborough for "Intentional" or all three when used together. 3. Edit for prepositions and infinitives 4. Note that Reflective Practice is what you engaged in to prepare for The Scholarship of Teaching; then, continue, as you do, and discuss "Critical Reflection" for students; Portfolio Assessment is a good example for Self-Assessment. Use some sources and check understanding and meanings. 5. Must source appropriately throughout; e.g. Assessment System, need to note Kuhs et al for basic model, then program and Jule for extended model, then you…… 6. Discuss results; itemize changes, then express how each change you implemented worked or did not work. Discuss what you think occurred, OR why it seemed to work or why not, then…. 6. **Close the loop**….identify changes for the next time based upon what was learned during this implementation. How did the students respond to the new course strategies? And, more. 7. Later, when you write the research manuscript, also: . **Close the Loop:** Also where are you going from here? What changes will this lead you to make in the course next time? Does this lead you to reconsider the design and research again or on to other research questions? New hypotheses?

! = excellent √ = appropriate first draft
NC = needs more consideration

Table B.12.5: Research Manuscript Review

Abdel-Motaleb Ibrahim Electrical Engineering	√ NC	*Instructional Research Project: Learning at the Expert Level "Investigation" of the Impact of Cooperative Based Learning on Engineering Student Learning"*	Yes	Yes	Yes	Yes	None; really need to build study context with literature Also need to interpret and discuss using literature How does your study fit into the picture; relate it to other studies; or note it as new or different	In context of results, but not in context of related research or theoretical literature	1. Need introduction to study and program; use education and learning terminology 2. Use more education and learning terminology 3. needs literature to set study context **Introduce more learning theory; theoretical basis for study 4. needs literature to interpret study results 5. needs to introduce study with questions, design, methods, procedures 6. needs to break away somewhat from lab report type writing to research manuscript style 7. research focus needs to be evident in title, abstract, or body 8. be clear about: "student learning outcomes," NAIT national standards (whereas ABET has labeled theirs "outcomes," we began with term objectives because that was traditional language and the way some had it in their course, as course learning objectives, etc. 9. be more specific about change process; that will impress readers and help them to understand magnitude of change 10. must source (e.g., individual vs. group learning accountability, Johnson, etc.) 11. need to source program, etc. 12. In intro, add intro to CEET program, etc.; that is the context of the study 13. what "uncontrolled variables" in concluding remarks; this would be great to discuss 14. Use boxes or graphics to present rubric, test items, etc. to separate them from other language 15. design graphics-lines off 16. consider overall organization and structure 17. . **Close the Loop:** Also where are you going from here? What changes will this lead you to make in the course next time? Does this lead you to reconsider the design and research again or on to other research questions? New hypotheses?

Applying Detailed Student Learning Objectives, Group Learning, and Assessments in an Introductory Polymers Course

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ABSTRACT

“Materials and Processes in the Plastics Industry” is a three credit-hour course at Northern Illinois University. It is an introductory course in plastics technology designed to familiarize the student with the basic polymers/plastics. The course has been reorganized to focus the learning process around the student and specific student learning objectives and outcomes connected to curriculum topics and various types of learning assessments. Higher-level objectives that stress designing, planning, judging, and analyzing are emphasized. Teaching is partially shifted to group learning and techniques are suggested to maximize the individual’s performance in a group setting. Scoring rubrics are part of the assessment system. Traditional examination questions are retained but now each question is connected to a specific student learning objective. Specific examples of learning objectives, syllabus content, a performance task, assessment rubric, and examination questions are presented for this, or any, introductory polymers course. Results for one application (semester) of this process are also presented.

BACKGROUND

At Northern Illinois University (NIU), an introductory polymers (plastics) course is offered within the Department of Technology. This three credit-hour course (TECH 344) is titled “Materials and Processes in the Plastics Industry” and is a three credit-hour course. The Department of Technology is part of the College of Engineering and Engineering Technology along with the Departments of Electrical, Industrial, and Mechanical Engineering. The Department of Technology is comprised of three undergraduate emphases: Manufacturing Engineering Technology, Electrical Engineering Technology, and Industrial Technology. Specifically for the Industrial Technology students, there is a plastics area of study and TECH

344 fulfills one of the required classes. Industrial Technology received initial accreditation from the National Association of Industrial Technologists (NAIT) in 1998 and has been reaccredited during the 2001/2002 academic year; the program is now accredited through 2008. TECH 344 is also taken by undergraduate students from Mechanical Engineering, Mechanical Engineering Technology, and other Industrial Technology study areas such as manufacturing and computer-aided design.

"Materials and Processes in the Plastics Industry" is an introductory course in plastics technology designed to familiarize the student with the basic polymers/plastics along with some plastics fabrication processes. Topics include

- History of Plastics;
- Basic Concepts in Organic Chemistry;
- Materials: Thermoplastics, Thermosets, and Elastomers;
- Properties;
- Additives, Fillers, and Reinforcements;
- Fabricating with Plastics;
- Recycling, Environmental Aspects; and
- Plastic Processing Methods.

There is no formal laboratory although there are demonstrations, in the laboratory, of some of the common plastics processing methods. (Plastics processing is extensively studied in another course, TECH 345.) Each student will have the opportunity to learn the origin, the identity, and the characteristics of the major plastics along with current process terminology and product applications. The course is similar to introductory polymer science or polymeric materials courses elsewhere in chemical engineering, materials science, and mechanical engineering or technology departments although the emphasis in TECH 344 is more on the properties and application of polymers rather than the chemistry. For example, the basic addition and condensation reactions forming polymers are included in the curriculum but details of reaction rates and the initiation, propagation, and termination reactions are not. Typically, students meet

twice a week for 75 minute sessions during a 16 week semester with the last week reserved for final examinations. Historically, students in TECH 344 are exposed to an instructor-centered command style[1] program where the instructor makes all the decisions and determines what is taught and how it is evaluated.

In 2006, in an effort to improve student instruction, performance, and retention, TECH 344 has been reorganized. Now the approach to learning is constructed around student learning objectives and outcomes connected to specific curriculum topics and various type of learning assessments. Various teaching and learning models have been incorporated with higher-level objectives of Bloom's Taxonomy[2] that stress designing, planning, judging, and analyzing rather than traditional recalling, classifying, summarizing, or naming. The reorganization of TECH 344 required revising the course content, syllabus, examinations, lectures, and projects.

STUDENT LEARNING OBJECTIVES

The first step in the reorganization process was the identification of each pertinent student learning objective (SLO) and ensure that course topics reinforced the objectives. The curriculum was adjusted to reflect all these changes. In the next step various teaching and learning models were incorporated to shift the program from instructor-centered to more student-centered where individually, or in groups, students take responsibility for the learning process. Finally, student assessments were developed to judge how well objectives are attained. This required analysis of previous course examinations, revision of these examinations, and development of new performance tasks that provide alternative assessments of the same knowledge. Rubrics were constructed to evaluate the performance tasks.

Two sets of learning objectives are present: general engineering NAIT and course-specific ones. For instance, a NAIT learning outcome or objective is:

Apply current knowledge and adapt to emerging application of math, science, engineering, and technology.

To achieve this outcome, TECH 344 includes the SLOs and sub-objectives of:

A. Students will Describe the Fundamental Structure of Plastics:

- A.1. Students will interpret and draw polymer chains.
  - A.1.a. Students will compare polymerization reactions.
  - A.1.b. Students will compare and contrast functional groups and tacticity.
  - A.1.c. Students will describe chain topology.
- A.2. Students will compare and contrast thermoplastics and thermosets.
  - A.2.a. Students will select commodity and engineered plastics.
  - A.2.b. Students will differentiate crystalline and amorphous plastics.
- A.3. Students will name, draw, and identify elastomers.
  - A.3.a. Students will explain elastomers.
  - A.3.b. Students will summarize polyisoprene.
  - A.3.c. Students will select and qualify other elastomers.

B. Students will Predict Plastics Properties:

- B.1. Students will describe effects of structural features on plastics properties.
  - B.1.a. Students will quantify and solve molecular weight distribution.
  - B.1.b. Students will qualitatively evaluate crystallinity effects.
- B.2. Students will distinguish and explain mechanical, physical, thermal, environmental, electrical, and optical properties.
  - B.2.a. Students will select ASTM techniques.
- B.3. Students will explain interactions of modifiers.
  - B.3.a. Students will classify additives, fillers, and reinforcements.

C. Students will Describe Plastics Design and Finishing Processing:

- C.1. Students will differentiate design methods.
- C.2. Students will classify ways of assembling plastics.
  - C.2.a. Students will select machining methods.
- C.3. Students will explain methods of finishing plastics.
  - C.3.a. Students will give examples of joining and decorating.
- C.4. Students will compare and contrast rapid prototyping procedures.

D. Students will Recognize the Environmental Aspects of Plastics:

- D.1. Students will explain waste reduction techniques.
  - D.1.a. Students will evaluate source control, recycling, regeneration, degradation, landfills, and incineration.

E. Students will Analyze, in Depth, Specific Plastics Topic:

E.1. Students will construct the history of a plastics topic, or
E.2. Students will differentiate a plastic, or
E.3. Students will detail a plastics processing method, or
E.4. Students will describe, in detail, a plastic product.

Appropriate textbook and lecture materials were selected to meet these objectives and the syllabus recorded the order and progress of meeting objectives and outcomes.

GROUP LEARNING ORIENTED SYLLABUS

A syllabus was planned that placed some of the burden of learning on the students. It combined instructor-centered instruction followed by student-centered group learning. As an example, part of student learning outcome A. is:

A.2. Students will compare & contrast thermoplastics & thermosets.
a. Students will select commodity and engineered plastics.

while the corresponding syllabus entries are:

Week and Objectives		**Day 1 Topics, Activities, and Due Dates**		**Day 2 Topics, Activities, and Due Dates**
Week #6 Select Thermosets Differentiate a Plastic		Commodity Thermosets.		Engineered Thermosets. Read Chapter 9 of Textbook due 10/9. Group: Students Differentiate Engineered Thermosets due 10/9. Homework: Chapter 8 Questions (evens) due 10/11.
Week #7 Name, Draw, & Label Elastomers		Polyisoprene. Group: Students Differentiate Polyisoprene due 10/11.		Other Elastomers. Performance Task 2 due 11/6. Homework: Chapter 9 Questions (evens) due 10/18.

These two weeks represent four class periods. In the first, day 1 of week 6, the focus is on instruction by lecture with the topic being commodity (common) thermosetting resins. But day 2 of week 6 represents a shift as students in groups, following the format examples from the instructor’s lectures, construct their own set of lecture notes for engineered thermosetting resins.

A due date for this assignment is given as 10/9 along with an individual homework assignment to further reinforce the material by presenting the same information from a different source to take advantage of various learning styles among students. (A similar approach is used in prior weeks for thermoplastics.)

In this regards, it is vital that any groups are legitimate cooperative learning groups where students are randomly assigned and outperform reasonable expectations by their combined efforts. Additionally, each individual in the group must be independently evaluated. Examples to accomplish this include keeping the group size small, giving written or oral examinations to students, and observing students as they interact within their group. There are systematic techniques available to maximize the individual's performance in a group setting[3,4]. These techniques cover various ways of forming groups, including ensuring that the groups are random and/or balanced. Different ways of group functioning and dynamic interaction are also documented. A sampling includes rounds where students take turns speaking; group investigation where each group is free to choose a subtopic within the area of study; discussions where students take opposing sides of an issue; and brainstorming to encourage free thinking and rapid development of ideas.

In any case, the vital elements of group learning are to assign personal responsibility to each student along with individual accountability. A group must actually engage in learning, not just doing a task or assignment; this requires the group to produce a product at the end of the session and the product must be assessed against very specific criteria. In the end, each student will perform at a level above their individual capability, benefiting from the group learning process.

Week 7 continues the process for elastomeric thermosets. Furthermore, week 7 contains an additional assignment labeled Performance Task 2 which provides another way for students to fulfill their learning objective of being able to understand specific polymers and addresses student learning objective E: *Students will Analyze, in Depth, Specific Plastics Topic.*

Performance Task 2 is also described in the TECH 344 syllabus:

You are charged with critiquing a specific plastic (or polymer) in detail. The focus is on what differentiates the plastic from other plastics by describing the features that make the plastic unique. The features would involve molecular structure, properties, and industrial, commercial, or consumer uses and applications. You must collect the appropriate information, coordinate your findings, judge the data, and write a report.

You will research the plastic from a variety of sources – internet, magazines, journals, manufacturers' datasheets, product literature, books, and conference proceedings. Keep track of all your research sources and be prepared to report on which were more useful. The research should include history of the plastic/polymer; fundamental molecular structure; molecular chain topology; molecular structural features and effects on properties; molecular weight distributions; basic, general mechanical, physical, and chemical properties; and uses and applications.

Devise a procedure for collecting your information prior to beginning the project. Choose which informational sources you will consult. Write down the procedure in a step-by-step order. Make sure proper documentation is maintained by complete referencing; use a system of referencing from a writing-style guide/handbook.

Present your findings in a written research report. Include data, tables, figures, diagrams, charts, graphs, references, and photos, where appropriate, to better illustrate your findings. The report must have a minimum of four pages of text (exclusive of references and illustrations: tables, graphs, figures, charts, photos, etc.) and be double-spaced with a 12-point font. The report should document and explain the plastic or polymer and its unique features and uses that, in your judgment, differentiate it from other plastics and polymers.

With lecture information, group learning, and homework assignments all reinforcing each other in the learning process, the student is ready to proceed to upper levels of Bloom's taxonomy; this performance task requires a higher-level of thought requiring judgment, evaluation and planning. Notice how the task is student-centered and uses verbs that promote action by the student.

ASSESSMENT

Of course to objectively assess student ability, it is necessary to provide, ahead of time, a scoring rubric specific for this assignment. The rubric covers research, writing, organization, and quality criteria of the work. A partial rubric for Performance Task 2 is:

Criterion	**Score = 3: Good**	**Score = 2: Acceptable**	**Score = 1: Weak**
Reference Use	Pertinent references are used; properly listed at end of report; and clearly cited within body of report.	Mostly pertinent references are used and properly listed at end but much text is not cited.	Little use of references.
Spelling/ Grammar	Few errors.	Some errors.	Many errors every page.
Organization	Topics are logically arranged with good flow between them. It is easy to follow lines of reasoning.	Sometimes difficult to follow topics and lines of reasoning.	Topics are mostly disorganized; hard to follow reasoning.
Critical findings or data.	Interprets results and data and properly applies interpretations to the conclusions.	Interprets results and data but does not successfully apply interpretations to conclusions.	No interpretation of results or data. No application to the conclusions.

Among assessment tools are examinations but these must truly test the material presented in class and be consistent with the SLOs. To accomplish this, an extensive test bank of questions was formulated. Question format was varied with the emphasis on questions that are objectively evaluated. Thus the format uses multiple choice, fill-in-the-blank, item matching, short answer, and true/false; it is important that lower-order as well as higher-order thinking questions are included [5]. Each test bank item may be characterized as knowledge, comprehension, application, analysis, evaluation, or synthesis, consistent with Bloom's taxonomy. Here analysis, evaluation, and synthesis represent high-order thinking test items and some test questions ought to be at such levels although higher-order problems solving may be better assessed through performance tasks and their rubrics. For TECH 344, an excerpt from the test bank gives some questions related to basic organic chemistry. The nine sample questions are grouped under student learning objective *A.1: Students will draw and explain basic organic molecules.*

1. The type of bond between two carbon atoms of a polymer is

a) covalent.
b) ionic.
c) dipolar.
d) metallic.

** For the next 6 items, write the typical number of bonds the element makes in the blank space next to the element.

2. hydrogen _____
3. sulfur _____
4. chlorine _____
5. carbon _____
6. fluorine _____
7. nitrogen _____

8. The molecular weight of heptane is a) greater than the molecular weight of heptene.
b) the same as
c) less than

9. Name the straight, four carbon-long chain molecule containing only hydrogen and single bonds: ______________.

By grouping test questions under SLOs, direct evidence is given that a specific area of knowledge is tested for. This is a useful asset in national educational accreditation programs as it provides proof of learning, once test scores and data become available. Quiz as well as midterm and final examination questions are selected from the test bank.

RESULTS

Results for one application (semester) of this process are presented. The results are grouped by significant student products such as exams and performance tasks.

Midterm Examination:

To improve on midterm scoring and in addition to lectures and homework assignments, the class was divided into two groups to assess the difference between cooperative versus individual learning in four content areas. The content areas were commodity thermoplastics,

engineered thermoplastics, thermosets, and elastomers. Random assignment of students to two groups allowed us to assume the groups were equivalent. Each group had approximately 15 students while each small learning group was composed of 3 students. The actual delivery of the treatment conditions alternated across content areas and groups. An outline of the experimental model is provided:

Individual Learning vs. Cooperative Learning

	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Midterm 10/18/06	----------→	Final 12/11/06
Cooperative Learning Group	Cooperative Learning	Midterm 10/18/06	----------→	Final 12/11/06

Treatment				
Group	Content Area I – Commodity Thermoplastic Study Summary Questions	Content Area II - Engineered Thermoplastic Study Summary Questions	Content Area III - Thermoset Study Summary Questions	Content Area IV - Elastomer Study Summary Questions
1	Individual - 15	Cooperative Groups #1-#5	Individual -15	Cooperative Groups #1-#5
2	Cooperative Groups #1-#5	Individual - 15	Cooperative Groups #1-#5	Individual - 15

From an item analysis viewpoint, I did not eliminate any items on the midterm; it only had two questions (out of 30) considered for elimination. Both of these had low Item Difficulty (11% and 21%) and Low Item Discrimination (-0.34 and 0.20). A closer examination of the two questions revealed that they were based on reading assignments and items not covered by lectures, student group assignments, or performance tasks. But the items were judged to be reasonable thus rather than eliminating them, I emphasized that the final would also include questions on the reading of chapters. (This includes material not covered in lectures.) It was also

noted that students did not perform better on the items from the four content areas related to the cooperative versus individual, traditional cognitive learning activities. Thus this led to another change to include more retention questions in the final than originally planned. A total of eight retention questions were included in the final, two from each of the four content areas.

In future courses, it would be beneficial to emphasize that students are responsible for chapter readings as well as lecture materials. Also other group learning models should be tried. There are systematic techniques available to maximize the individual's performance in a group setting. These techniques cover various ways of forming groups, including ensuring that the groups are random and/or balanced. Different ways of group functioning and dynamic interaction are also documented. A sampling includes rounds where students take turns speaking; group investigation where each group is free to choose a subtopic within the content area of study; discussions where students take opposing sides of an issue; and brainstorming to encourage free-thinking and rapid development of ideas. Overall, individuals should benefit from the group learning process but this did not occur presently.

Final Examination:

Due to rewriting of items based on experiences from the midterm, the overall class performance on the final examination was 10% better than the midterm. There were three questions (out of 50) with low Item Difficulty (14% and two at 21%). However two of these had reasonable Item Discriminations (0.44 and 0.47) while the third was at -0.34. This third item was discussed in lecture and included in the textbook readings so that there is no good explanation of why the item proved to be so difficult; only this item was considered for elimination. Three items had Item Difficulty scores of 100%; these items show no discrimination and also could be considered for dropping. But, in the end, all items were retained as a database to be expanded as

future exams give more guidance as when to eliminate items. Certainly, it is expected that the experiences from these two examinations will provide for better future test items.

There was even better improvement on the eight retention questions; the students scored 12% better on the retention questions than on the final as a whole. This indicates that if special, or extra, attention is given to critical topics, students are able to perform. Different teaching and/or learning models ought to be considered for such topics. This, in conjunction with better group learning processes, should increase test performance, including performance on retention items.

Performance Assessments:

Three performance assessment tasks were assigned. Generally, scores were better on these than the standard tests as the tasks gave students an alternative opportunity to give evidence of their knowledge. The tasks also tested the students at higher levels of Bloom's taxonomy. One of the reasons for the success of these was the presence of rubrics that were a great asset in the execution of the performance assessment tasks. Students clearly knew the expectations and tailored their work to fulfill the requirements. This led to higher scoring and the better scores were justified.

The third task included group activities. It appears that students working in groups towards performance tasks benefit more than groups preparing for the midterm and final examinations. Students seem to do better in group settings where more creative, open-ended projects are the goal. Future courses should explore and exploit this trend. Or a cooperative versus individual learning study for performance tasks could be conducted.

CONCLUDING REMARKS

After several offerings of TECH 344 with its revised format, more data should be collected to determine whether or not student learning has improved. Test scores and grades from this initial offering is a baseline. However, if there remain too many uncontrolled variables, meaningful quantitative, statistical findings will be difficult. Nevertheless, even qualitative data and instructor experience should provide an evaluation of the program. Of course reorganization of TECH 344 is expected to be a continual process as more feedback and information arrives each time the course is given.

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Design of an Introductory Digital Electronics Course within an Electrical Engineering Technology Undergraduate Program

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1. Introduction

One of the major issues of educational research is to enhance students' learning. As identified (AACU, 2002; Fox and Hackerman, 2003; Bransford *et al.*, 1999), the factors that enhance students' learning are: a) enable students to become empowered, informed, and responsive learners ready to assume a productive role in society; b) improve assessment of learning outcomes, teach a broader range and larger number of students, provide engaging laboratory and field experiences, and enhance faculty knowledge of research on effective teaching; c) work with students' pre-existing knowledge, teach subject matter in depth and provide examples, help students to develop self-monitoring and reflection skills, and integrate these practices into the curriculum in a variety of subjects; and d) share ideas and materials so that projects build on, connect to, and enhance the work of others.

To address these issues, scholarship of teaching has receiving attention and there has been much debate about what sort of teaching encourages effective learning (Biggs, 1996, 1999; Ramsden, 1992; and Prosser and Trigwell, 1999). In a simple statement, scholarship in teaching is an effort to make the teaching process transparent so that one can understand how learning takes place (Trigwell, 2007). For this to happen, teachers must be informed of the theoretical perspectives and literature of teaching and learning in their discipline, and be able to collect and present rigorous evidence of their effectiveness. One of the ways to achieve these is to adopt intentional instructional design with reflective practice.

1.1 Intentional Instructional Design

Intentional instructional design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. Instructional design is the science of creating detailed specifications for the development, preparation of instructional materials, implementation, evaluation, and maintenance of situations that facilitate the learning of both large and small units of subject matter at all levels of complexity.

Instructional-design theory includes *instructional outcomes, conditions, methods, and values*. *Instructional outcomes* include both results that are intentional and those that are incidental. This includes the instruction's effectiveness, efficiency, and appeal and should not be confused with learning outcomes. Instructional outcomes focus on the degree of success in attaining the desired learning outcomes (the effectiveness of instruction) but also include the efficiency and appeal of the instruction. *Instructional conditions* are factors beyond the influence of the instructional designer that impact upon the effects of the methods of instruction. Conditions may include the nature of what is being learned (the content), the learner, the learning environment, and the instructional development constraints (resources). *Instructional methods* are the "how to" facilitate human learning. They are the elements of guidelines that inform

designers and teachers what to do to help students learn. Instructional methods are situational rather than universal. This means that there are values, desired instructional outcomes, and instructional conditions (collectively referred to as instructional situations) in any context that influence whether or not a given instructional method should be used. Also, instructional methods are probabilistic rather than deterministic. That is, their use can only increase the probability that the desired outcomes will be attained. *Instructional values* are an individual's or group's philosophy or beliefs about instruction.

1.2 Reflective Practice

The reflective practice is one of the major components of scholarship in teaching. There are three activities that support the facilitation of reflective practice: self and peer assessment, problem-based learning and personal development planning. One needs to decide which approach will best meet for a specific need given the course objectives and context.

Self and Peer Assessment: Both self and peer assessment can be used to support reflective practice, since they involve students thinking about their own learning. According to the pioneering work of Boud, self and peer assessment is the "involvement of students in identifying standards and/or criteria to apply to their work and making judgments about the extent to which they have met these criteria and standards" (Boud, 1995). It implies that self assessment involves two clear stages: a) the identification (and learner understanding) of standards and criteria for a given task and b) the making of one's own judgments against those criteria.

Self assessment can be used to facilitate both a process of learning and an assessment product. It can be used in an informal way to encourage students to think about their work and what they know in a given subject. The evidence of development through self assessment can be expressed through writing a learning diary or portfolio.

As the name suggests, peer assessment involves students making judgments about the quality of each other's work in relation to an agreed criteria. This is a useful tool for supporting reflective practice, as it focuses on dialogue and shared interpretations of teaching and learning between teachers and students (Stefani, 1998). Students learn from each other and use the feedback provided by peers to inform their own learning. Peer assessment enables students to understand and communicate ideas that they consider important with the lecturer and their peers about what should be assessed and what weighting should be given to each specific criterion (Tribe and Tribe, 1986; Hinett and Thomas, 1999). Using this approach student is encouraged to make qualitative comments about the work of their peers. To promote a sense of ownership over the process, students may also be asked to attribute a grade to the work and experience suggests that students prefer and enjoy in assigning a grade as well as providing comments (Boud and Tyree, 1980). Research findings suggest that in cases where they are involved in grading there is often more congruence between the student and tutor’s mark (Stefani, 1994; Boud and Falchikov, 1989).

The key to using self and peer assessment is to ensure that each student is given the same opportunities to discover how they learn. At the same time it is a good idea not to streamline the process, but allow students’ need to discover for themselves what they know and don't know and to make their own connections if these processes are to support reflection.

Problem-Based Learning: Problem-based learning (PBL) is used as a way of engaging students in real problems. Unlike conventional teaching, PBL starts with a problem and requires the

student to research, select, analyze, and apply information and theories to solve it. Students work in groups or teams to solve or manage these situations, but they are not expected to acquire a predetermined series of right answers. Instead they are expected to engage with the complex situation presented to them and decide what information they need to learn and what skills they need to gain in order to manage the situation effectively (Savin-Baden, 2000).

The advantage of students working upon real or simulated situations is that real problems do not have simple solutions, but require comparison and analysis of resources, strategies and costs. As such the learner has to develop skills of retrieval, selection and discrimination in order to solve the problem. Students also develop group working skills as they work together to solve a common problem. PBL facilitate a dialogue between the student, tutor, and peers (and in some cases external parties), which helps the individual make sense of his or her learning. Laurillard, outlines that dialogue has three important functions for learning; firstly it reveals the students' and teachers' conceptions to each other, secondly it provides space for negotiation and adaptation of topic and task goals, and thirdly and perhaps most importantly, it provides opportunity for feedback, reflection, and action upon feedback (Laurillard, 1993).

PBL offers a genuine experience or context in which reflection can take place, and unlike traditional problem solving where the student is directed towards appropriate resources, PBL forces students to think on their feet and draw on previous experience to transfer to new settings (Boud and Feletti, 1997).

Personal development planning: Personal development planning (PDP) aims to provide students with a structure for thinking about and planning their own development and can be seen as a process of evidencing learning and reflection. Portfolios and records of achievement are the common forms in which the PDP process is presented. The advantage of PDP is that it provides a rounded picture of the capabilities of an individual. Usually consisting of three parts (a checklist of skills or competences achieved, evidence of achievement, and a reflective piece on how the skill has been developed), PDP offers more information than a certificate and engages students in a process of thinking about their learning. Portfolios can be used both for certification purposes and as an additional form of evidence to employers and educational institutions. It is intended that PDP will help students to: become more effective, independent and confident self-directed learners, understand how they are learning and relate their learning to a wider context, improve their general skills for study and career management, articulate their personal goals and evaluate progress towards their achievement, and encourage a positive attitude to learning throughout life.

PDP is also about improving and encouraging dialogue between learners and teachers. Discussion-based seminars offer a structured and supported PDP process. PDP offers another way of encouraging students to think about what they know, what they don't know and how they might develop the skills to fill the gaps in their knowledge such that their appreciation of the subject area improves. It also enables discussion between learners and other parties, and introduces students to the discipline of evidencing and documenting work.

1.3 Background of the Reported Work

During the summer 2006, the College of Engineering and Engineering Technology (CEET) of Northern Illinois University took an initiative towards scholarship of teaching and learning. The goal of this initiative was to: *Institutionalize and sustain a program of faculty development on*

teaching, student learning, and educational research to prepare faculty to engage in scholarship of teaching through action research in the classrooms. As a starting of this initiative, during the summer, a group of CEET faculty underwent an intensive workshop on course design and development. In the following Fall semester, the group has conducted an educational research using their developed courses. The author is a member of this group and has designed and developed and introduced an introductory level digital design course within an undergraduate program and subsequently implemented it for the course.

The paper will present the course design and development part of the activity through reflective practice and intentional instructional design. In the process the author has studied various teaching models, teaching and learning styles, taxonomy, active learning, students learning outcomes and their relation to the ABET standards and learning levels, assessment planning, item development, test formulation, and test analysis.

The next section describes the course analysis that studies various fundamentals of teaching and learning theories along with the structure of target course design. Section three illustrates a comprehensive assessment plan by highlighting the assessment tools that are being used during the course implementation process. Section four presents the objective item development and test formulation process. Section five discusses the test analysis and its importance to maintain the quality of objective tests. These are followed by the conclusions, acknowledgements, and references.

2. Course Analysis

This section involves the study of teaching models, teaching and learning styles, active learning, and bloom's traditional and revised taxonomy along with the development of students learning objectives, content outlines and course priorities.

2.1 Teaching Models

Before moving further into the course design, it may be good idea to provide with a discussion on teaching models. Teaching models describe a learning environment, including the behavior of the teachers when that model is used. The models can be grouped into four families, whose members share orientations towards human beings and how they learn: a) the information processing family; b) the social family; c) the personal family; and d) the behavioral systems family (Joyce *et al.*, 2004)

Information processing family: emphasis ways of enhancing the human being's innate drive to make sense of the world by acquiring and organizing data, sensing problems, and generating solutions to them, and developing concepts and languages for conveying them. Some models provide the learner with information and concepts, emphasize concept formation and hypothesis testing, and other generate creative thinking. The models under this family are- inductive thinking, concept attainment, scientific inquiry, inquiry training, mnemonics, synectics, and advance organizers.

Social family: are constructed by building learning communities that generate a collective energy that call synergy. The models under this family are- partner in learning, group investigation, role play, and jurisprudential inquiry.

Personal family: pays great attention to the individual perspective and seeks to encourage productive independence, so that people become increasingly self-aware and responsible for their

own destinies. The models under this family are- nondirective teaching and enhancing self-esteem.

Behavioral systems family: includes programs for reducing phobias, learning to read and compute, developing social and athletic skills, replacing anxiety with relaxation, and learning the complexes of intellectual, social, and physical skills

2.2 Teaching and Learning Styles

Felder presented a discussion on teaching and learning styles (Felder, 1993). They presented that students learn many ways, by seeing and hearing, reflecting and acting; reasoning logically and intuitively, memorizing and visualizing and drawing analogies, and building mathematical models. At the same time teachers also use various styles for their teaching, such as lectures, demonstration, leading students to self-discovery, principles, application, memory, and others on understanding. It has proven that increased learning gains can be achieved when instructions is designed with students' learning styles in mind (Briggs, 1977). Also, attention to learning styles and learner diversity has been shown to increase student motivation to learn (Hein and Budny, 1999). In early 90's, based on Carl Jung's Dialectic Tension, and Kurt Lewin's Experimental Learning Theory Dr. Kolb devised his learning style inventory (Kolb, 1985). It divides students' population into four groups depending upon what a person is like, as opposed to reasoning and thinking skills. The categories are: type 1- concrete, reflective; type-2 abstract, reflective; type-3 abstract, active; and type-4 concrete, active. An objective of education should thus be to help students build their skills in both their preferred and less preferred modes of learning by considering various teaching and learning styles.

2.3 Active learning and Taxonomy of Learning Analysis

Students learn best when they are actively involved in the learning process and the experiences are concrete rather than abstract. Active learning is not merely a set of activities, but rather an attitude on the part of both students and faculty that makes learning effective. The objective of active learning is to stimulate lifetime habits of thinking to stimulate students to think about how as well as what they are learning and to increasingly take responsibility for their own education (Hatfield, 1995). Students whose teachers emphasize higher-order thinking skills and hands-on learning activities outperform their peers significantly. Students who engage in hands-on learning on a weekly basis outperform those who engage in this manner of instruction on a monthly basis. Students whose teachers conduct hands-on learning activities outperform their peers by 72% of a grade level in math and 40% of a grade level in science. This study indicates that the most effective classroom practices involve conveying higher order thinking skills and engaging in hands-on learning activities (Educational Testing Service 2001).

According to Dale's research on teaching and learning there is a cone of leaning which represent the level of learning with respect to the type of activities students are involved with (Dale, 1969). As presented in Figure 1, the least effective method, the top of the cone, involves learning from information presented through verbal symbols, i.e., listening to spoken words, while the most effective method, the bottom of the cone involves direct, purposeful learning experiences, such as hands-on or field experiences.

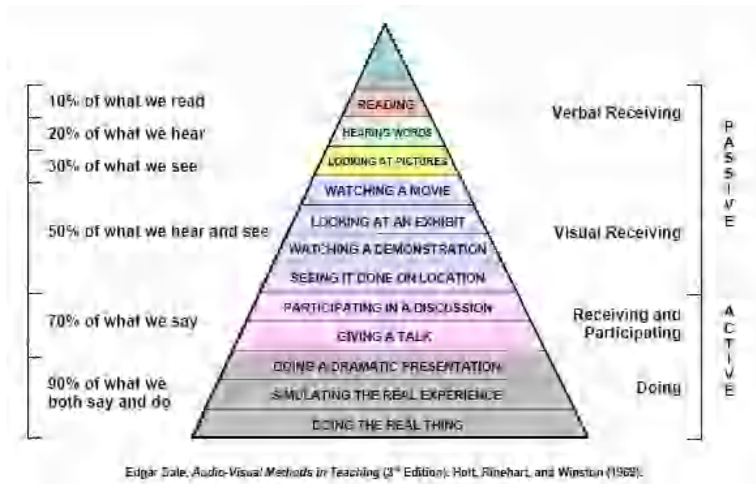

Figure 1: Dale's cone of learning (developed and revised by Bruce Hyland).

The cognitive domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. Bloom created a learning taxonomy that categorize competency level in the cognitive domain (Bloom, 1956). According to this, there are six major categories: *knowledge*- the ability to remember and state previously learned materials, *comprehension*- the ability to grasp the meaning of material and to restate it in one's own words, *application*- the ability to use learned material in new and concrete situations, *analysis*- the ability to break down material into its components so as to understand its organizational structure, *synthesis*- the ability to put parts together to form a new whole system, and *evaluation*- the ability to judge the value of material for a given purpose. The categories can be thought of as degrees of difficulties. It starts from the simplest behavior as knowledge to the complex one as evaluation. To keep the importance of Bloom's work relative to today's theories, Anderson and Krathwohl (2001) revised Bloom's original taxonomy by combining both the cognitive process, and knowledge dimensions. This new expanded taxonomy, called Bloom's revised taxonomy that help instructional designers and teachers to write and revise learning. The learning levels are: *creating*- putting together ideas or elements to develop an original idea or engage in creative thinking; *evaluating*- judging the value of ideas, materials and methods by developing and applying standards and criteria; *analyzing*- breaking information down into its component elements; *applying*- using strategies, concepts, principles and theories in new situations; *understanding*- understanding of given information; and *remembering*- recall or recognition of specific information.

2.4 Student Learning Objectives

A Student learning objectives (SLO) is a statement of exactly what students should be able to do after completion of the course or at specified points during the course. These objectives should be measurable and must use an action verb (e.g., such as define, classify, construct, compute, etc) rather than nebulous verbs reflecting internal states that cannot be observed (e.g., known, learn, understand, realize, and appreciate). Student's performance verbs by level of cognitive operation based on Bloom's Taxonomy is provided below (Nilson, 2003):

Knowledge- arrange, order, define, recall duplicate, recite, label, recognize, list, relate, memorize, repeat, name, and reproduce.

Comprehension- classify, locate, describe, recognize, discuss, report, explain, restate, express, review, identify, select, indicate, and translate.
Application- apply, interpret, choose, operate, compose examples, practice, demonstrate, schedule, dramatize, sketch, employ, solve, illustrate, and use.
Analysis- analyze, differentiate, appreciate, discriminate, calculate, distinguish, categorize, examine, compare, experiment, contrast, question, criticize, and test.
Synthesis- arrange, integrate, assemble, manage, collect, organize, compose, plan, construct, predict, create, prepare, design, propose, formulate, and set up.
Evaluation- appraise, evaluate, argue, judge, asses, rate, challenge, score, choose, select, defend, support, dispute, and value.

A total of seven major SLOs have developed for the target course, and all these objectives are mapped with the intended teaching styles, learning styles, learning model, Dale's learning, Bloom's traditional and revised taxonomy. This mapping is presented as a tabular form in Appendix-A and the table will be used later when planning for assessment strategies. In the table, the course is composed of fifteen weeks of teaching with two one and half hours of class per week.

2.5 ABET Outcomes and Student Learning Objectives

As an ABET (accreditation boards of engineering and technology) accredited program, it is a requirement for the course to address some of the ABET program outcomes that are based on the needs of the program's constituencies. The measurable outcomes that are provided by the ABET are (ABET, 2007):

(a) An ability to apply knowledge of computing and mathematics appropriate to the discipline
(b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
(c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
(d) An ability to function effectively on teams to accomplish a common goal
(e) An understanding of professional, ethical, legal, security and social issues and responsibilities
(f) An ability to communicate effectively with a range of audiences
(g) An ability to analyze the local and global impact of computing on individuals, organizations, and society
(h) Recognition of the need for and an ability to engage in continuing professional development
(i) An ability to use current techniques, skills, and tools necessary for computing practice.

The ABET outcomes, those are addressed through the course are mapped with all the SLOs. At the same time, it also shows which Bloom's cognitive process level will be achieved while addressing each of these SLO. Appendix-B is shows the mapping of SLOs for only one of the ABET outcomes.

2.6 Content Outline, Course Priorities, and Content Schedule

The course that was designed, developed, and reported is an introductory level digital electronics course within an undergraduate electrical engineering technology (EET) program of Northern Illinois University (NIU). After the study of all the theories and their possible use for the course the next task was to identify the course outline underlining the major topics, required science foundation, required mathematics foundation, and communication foundation skills. Appendix-C shows the worksheet with all these information.

Sometimes, it is not always possible to address/deliver all the listed topics within a course schedule. It is helpful for the faculty if the topics can be identified with their priority levels. The

priority levels can be laid out into three stages: essential, possible to escape, and not essential. The faculty must cover the essential topics and try to cover the other two if possible. The course outline with these priority levels is provided in Appendix-D.

For more detailed planning a day-to-day map was developed with each course topics along with corresponding teaching and learning models, learning styles, bloom's learning level, and dales cone of active learning. The table is showing in Appendix-E.

3. Assessment and Evaluation Plan

Assessment is one of the core parts of the course development activities. Assessment is the process of gathering and discussing information from multiple and diverse sources in order to develop a deep understanding of what students know, understand, and can do with their knowledge as a result of their educational experiences; the process culminates when assessment results are used to improve subsequent learning (Huba and Freed, 2000). The business community axiom that *What gets measured, gets done* holds true in education as well. There are four fundamental elements of assessment and evaluation process: a) Formulate statements of intended learning outcomes; b) develop assessment tools; c) implementation of tools; and d) evaluate the assessment results to improve learning.

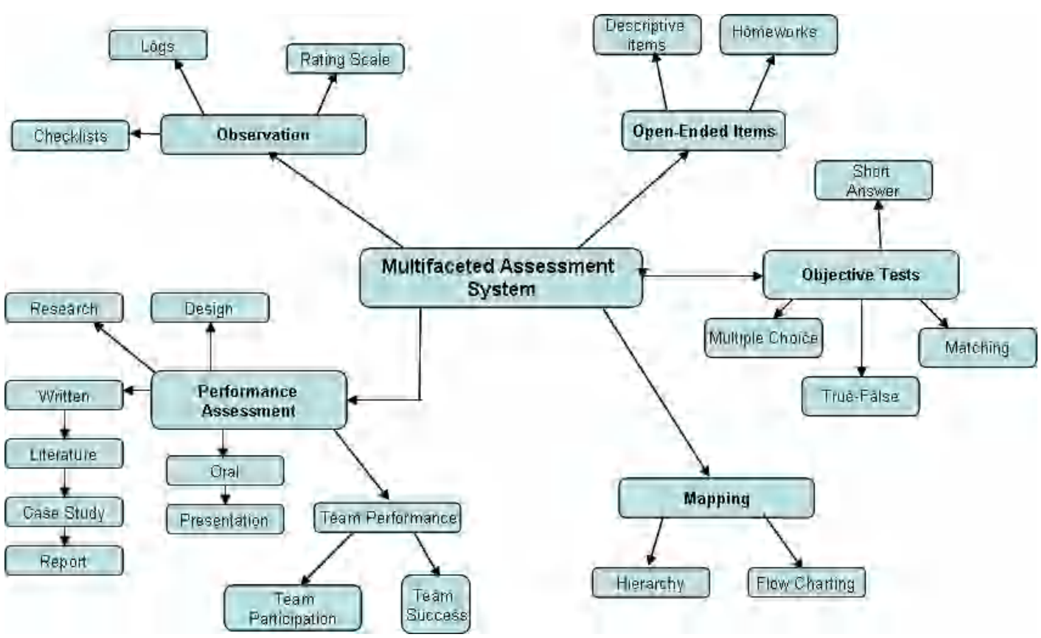

Figure 2: Multifaceted assessment plan.

A best approach is to use a variety of assessment tools or procedures to produce a balanced system over the course to attain the identified standards (Scarborough, 2005). A balance system should include good and reliable traditional assessment, performance assessment, and other methods. It is important to include as many assessment tools as possible to provide accurate and useful information for making decisions about learning. Objectively scored items are prepared to focus on factual knowledge and at the same time they assess knowledge bit by bit, item by item, typically with no reference to any eventual real-world application (Resnick and Resnick, 1992). They are only indirect indicators of more complex abilities such as reasoning about cutting-edge issues or using information to solve important problems in a particular field.

However, the challenges faced by adults in general and by professionals in particular fields tend to be those that require the simultaneous coordination and integration of many aspects of knowledge and skill in situations with few right answers.

The aim of the reported course development process was to develop a multifaceted assessment plan by including a number of assessment tools. The developed assessment plan is shown in Figure 2. The assessment plan incorporates five different kinds of assessment tools: a) observation; b) open-ended tests; c) objective tests; d) mapping; and e) performance assessment. A table has been developed to map how these assessment methods will address various levels of Bloom's learning taxonomy (Appendix-F).

Observation: is the planned viewing and analysis of students, their work environment, and their interactions with other students, and their teachers. Observations are an opportunity to see how students solve problems and to learn, what factors may affect their ability to learn, complete work, and interact in a positive way with others. Observations are an important part of the special education diagnostic assessment process. They can be used for general information gathering or designed to identify specific behaviors. They can assess the student's ability to perform specific tasks and pinpoint exactly where students make mistakes in their work. They can be unstructured narratives, semi-structured forms, or highly structured, as in standardized behavior checklists. Within the proposed assessment plan checklists, logs, and rating scale are to be adopted under this category.

Open-ended: is the subjective type of assessment tools. To assess the test items the faculty needs to make a personal judgment as to the quality of the response e.g. the literary merits of an essay or the artistic merits of a painting. In open-ended assessments it usually takes longer to judge and teacher's judgment is one of the main factors towards grading. These questions are lengthy in nature and take longer time to grade than objective questions and therefore only include a small number of questions, focusing on complex concepts. Within the proposed assessment plan, descriptive items and homeworks are used.

Objective test: items will have only one right answer so there is no human factor involved in the grading process. There is a range of item types that one can choose for objective test development. Some of these are: <u>Multiple choice</u> questions (MCQs) are the traditional ones where students choose one from a list of possible answers. <u>True/False</u> questions require a student to assess whether a statement is true or not. <u>Assertion-Reason</u> questions combine elements of MCQ and true-false. <u>Multiple response</u> questions (MRQs) are similar to MCQs, but involve the selection of more than one answer from a list. <u>Matching</u> questions involve linking items in one list to items in a second list. <u>Ranking</u> questions require a student to relate items in a column to one another and can be used to test the knowledge of sequences, order of events, and level of gradation. <u>Sequencing</u> questions require the student to position text or graphic objects in a given sequence. These are particularly good for testing methodology. For the proposed assessment plan, only multiple choice, true-false, and matching will be implemented. However, other kinds of items are also a candidate for future developments.

Mapping: It has been established that the essence of knowledge is structure (Gasper and Candaday, 2000; Anderson, 1984). Assuming that knowledge within a content domain is organized around central concepts, to be knowledgeable in the domain implies a highly integrated conceptual structure among those concepts. As expertise in a domain grows, through learning, training, and/or experience, the elements of knowledge become increasingly

interconnected (Chi, *et al.*, 1988). Considering this concept maps have been proposed as a more direct approach for capturing the interrelatedness among concepts in a domain (Ruiz-Primo and Shavelson, 1996). Concept maps have been shown to be a viable method for assessing students' understanding. Concept map as assessment methodologies have been developed that use both closed-ended concept maps (Ruiz-Primo and Shavelson, 1996) and open-ended concept maps (Abrams, *et al.*, 2006). In the proposed assessment plan two kinds of mappings are incorporated (hierarchy and flow charting).

Performance assessment: is a measure of assessment based on authentic tasks such as activities, exercises, or problems that require students to show what they can do (McBrien and Brandt, 1997). Some performance tasks are designed to have students demonstrate their understanding by applying their knowledge to a particular situation. Performance tasks often have more than one acceptable solution; they may call for a student to create a response to a problem and then explain or defend it. The process involves the use of higher-order thinking skills (e.g., cause and effect analysis, deductive or inductive reasoning, experimentation, and problem solving). Performance tasks may be used primarily for assessment at the end of a period of instruction, but are frequently used for learning as well as assessment.

Performance assessment is one of the major components within the developed course assessment plan. As proposed students will perform three performance assessment tasks throughout the duration of the course. Implementation of these performance assessments involves research, design of a system, written report with literature survey, oral presentation, and team activities. All these will be assessed to establish the level of learning that has been achieved by the students in terms of dealing with real-life problems within the given subject area.

Sometime it is difficult for students to understand what has been expected by the faculty from a performance assessment task. This can causes considerable amount of misunderstanding between the students and a faculty and hinder the achievement of expected level of expertise. To handle this problem it is important to develop a rubric while writing a performance assessment.

A rubric is a set of scoring guidelines/criteria for evaluating a given performance assessment task. A rubric answers a number of questions: a) criteria that would be used for judging; b) difference between good work and weaker work; c) present the judging scores; and d) to work towards excellence. In general, rubrics make public the key criteria that students used in developing, judging, and revising their work (Scarborough, 2005). Rubrics hold both the student and teacher accountable. Students know and understand what they have to do to achieve at establish levels, and teachers cannot change the rules once the rubric are circulated. Rubrics also build consistency in scoring or grading, while reducing bias. One of the developed performance assessment along with its rubrics are provided in Appendix-G.

4. Item Development and Test Formulation

Item development is a process where a faculty develops a range of test items for each learning outcomes while addressing the intended level of expertise as identified earlier. The goal is to maintain a pool of examination items which are appropriate to measure the knowledge and skills necessary for effective performance in the field of practice (Lunz, 2004). There is a number of issues one should consider while developing these test items: a) developing new items on a continuing basis; b) reviewing and selecting items for inclusion in the written examination; c) monitoring the content, task, and cognitive skill distributions of items; d) monitoring the content

quality and difficulty of each item and avoiding duplicate items on the same knowledge/skill; e) providing expert input into the criterion standard against which candidates are measured; and f) reviewing the performance of each item to ascertain the quality of the content and structure of the item. In brief, item development is an ongoing process where a faculty develops, rewrite, modify, and delete items as time passes by.

The reported course development process involves test development only for the objectives tests. According to the assessment plan the items to be developed are of short answer, multiple choices, true-false, and matching. The items are developed for each of the students learning objectives while addressing each learning levels. Table-1 shows a list of test items that have been developed for first five SLOs' while considering identified Bloom's level of learning.

Table-1: Developed test items for SLOs.

Student Learning Objectives				**Assessments: Test Alignments Midterm & Final**
	Student Learning Objectives-Major	**student learning objectives - minor**		**Corresponding Tests and Test Items**
1.	To examine the components of a digital system.	**a**	To contrast between analog and digital signals	Multiple choice: 1aA1, 1bC1, 1cC1, 1cC2, 1dK1, 1dK2, 1eC1
		b	To classify binary digits, logic levels, and digital waveforms	
		c	To compare basic logic operations	
		d	To categorize fixed function integrated circuits	
		e	To interpret the operation of simple digital systems	
2.	To examine the structures for various number systems.	**a**	To distinguish between various parts of number systems.	Multiple choice: 2aC1, 2aA1, 2bC1, 2bC2 Short answer: 2aK1, 2aK2, 2aK3, 2aC1
		b	To examine the counting in binary, octal, decimal, and octal.	
3.	To distinguish the conversion methods for various number systems.	**a**	To convert between binary and decimal	Multiple choice: 3aA1, 3aA2, 3aA3, 3aA4, 3aA5, 3bA1, 3bA2, 3bA3, 3cA1, 3cA2 Short answer: 3cC1, 3bA2, 3bA3, 3cA1, 3cA2
		b	To convert between binary and hexadecimal	
		c	To convert between binary and octal	
4.	To perform different binary arithmetic operations: addition, subtraction, 1's complement, 2's complement, and signed numbers.	**a**	To examine the basic rules involving each of the operations.	Multiple choice: 4aC1, 4aC2, 4aC3, 4bA1, 4bA2, 4bA3, 4bA4. Short answer: 4bA1, 4bA2, 4bA3, 4bA4, 4aK1
		b	To use the rules to perform each of the operations.	
5.	To examine the operation and use of various logic gates with different input patterns: AND, OR, and NOT, NAND, NOR, XOR and XNOR.	**a**	To develop the truth tables of various logic gates using established rules.	Multiple choice: 5bC1, 5bC2, 5cA1, 5dA1, 5dA2, 5cA2, 5dA4, 5dA5. Short answer: 5bC1, 5bC2, 5bC3, 5bC4, 5bC5, 5bC6, 5dC1, 5dC2
		b	To use the truth tables to identify output pattern of a logic gate for a given set of input.	
		c	To predict output logic levels for a pulse input pattern.	
		d	To recommend the use of appropriate logic gate(s) for a given application.	

After developing a reasonable amount of test items for each of the SLO, it is now possible to formulate a test using the developed test items.

5. Test Analysis

For traditional test methods, such as open-ended items and selected response items, it is important to assess the effectiveness of the items in terms of the objectives of the assessment. Test analysis is the process of collecting, summarizing, and using information from students test scores to make decisions about each item (Nitko, 2004). This analysis helps a faculty to: determine whether an item functions as it was intended, feedback to student about their performance and as a basis for classroom discussion, feedback to the faculty about students' difficulties, areas for curriculum development, and revising the assessment tasks and improving item-writing skills.

Table 2: Test analysis of an examination.

Item	1a	1b	1c	1d	2	3	4	5	6	7	Total Across Items (Student Scores)	
Points Possible	2	2	2	4	10	16	16	16	16	16	100	100%
Students												
	2	2	0	4	10	14	13	13	12	10	80	80%
	1	2	2	3	10	8	8	16	8	8	66	66%
	1	2	2	4	10	10	10	10	9	8	66	66%
	1	1	1	4	10	14	16	12	10	10	79	79%
	2	2	2	4	9	16	12	16	12	16	91	91%
	2	2	2	4	8	16	12	16	16	16	94	94%
	1	2	2	1	10	13	16	15	10	11	81	81%
	2	2	2	4	10	16	8	12	10	12	78	78%
	2	0	0	0	0	0	8	6	4	4	24	24%
	0	0	0	4	8	16	6	15	10	10	69	69%
	1	1	1	4	10	15	16	16	10	16	90	90%
	0	0	0	0	0	0	0	0	0	0	0	0%
	2	2	0	4	10	13	16	16	16	14	93	93%
	0	0	0	4	8	12	10	10	0	0	44	44%
	2	2	0	4	10	12	9	16	10	4	69	69%
											911	70%
Totals Across Students (Item Scores)												
Max Item Scores	26	26	26	52	130	208	208	208	208	208	1300	
Item Score	17	18	14	40	105	151	141	163	127	135	911	
Item Difficulty	65%	69%	54%	77%	81%	73%	68%	78%	61%	65%	70%	
Item discrimination	0.44	0.71	0.44	0.81	0.89	0.92	0.79	0.93	0.93	0.94		

The test analysis involves few steps: a) tabulating all the details about the test items (such as students details, maximum mark for each items, marks attained for each items); b) calculate the difficulty index for each item; and c) calculate the discrimination index for each item. Item difficulty index is the fraction of the total group answering the item correctly. Fraction range can vary between 0.00 and 1.00. When the fraction tends towards 1.00 indicates that the item was

easy for the students. It is for the individual faculty to set a desired item difficulty for a given course/examination to consider a test item as easy or difficult. Item discrimination index is the relationship (the correlation) between the students' performance on the items and the student proficiency in the content the item measures. The item should discriminate between the proficient students and the non-proficient students. Proficient students should do well on the item, non-proficient students should not do well. In terms of measuring student's proficiency, scores on the entire examination is considered as a measure of the student proficiency. Therefore, the item discrimination is measured as the correlation between students' scores on an item and students' scores on the entire examination. As a test case, an item analysis is presented for a course that was conducted by the author in the past (Table-2). Within the test there were a total of ten items, with an aggregate maximum possible item score can be 1300, where students achieve 911. Item difficulty for individual items varies between 54% and 81%. When item discrimination varies between 0.44 and 0.94.

6. Discussion

Usually, almost all the engineering and engineering technology faculty starts their teaching carrier with the highest degree in their professional area. Having a terminal qualification in the subject, it is expected that one can teach a course with full authority. There is a conception that teaching and learning is a subject area of education discipline, it is nothing to do with engineering and engineering technology. However, the fact is, in addition to knowledge in the subject area a teacher should use appropriate course design techniques, proper delivery of a course, and plan for a suitable assessment strategy. The reported course development exercise following an intensive teaching and learning institute provides a valuable lesson for the author. Although, the author was using some of the techniques from his prior learning from various sources, this initiative allows him to think a course design and development much more comprehensive manner, while considering available teaching and learning theories and practices.

7. Conclusions

The paper reports the design and development of an introductory level digital electronics course for an undergraduate EET program. The process has been divided into seven stages: (a) study of intentional instructional design and reflective practices; (b) course analysis while considering teaching models, teaching and learning styles, Dale's cone of learning and Bloom's traditional and revised taxonomy, and ABET outcomes; (c) development of student learning objectives while addressing all the issues mentioned in (b); (d) development of course outline, course priorities, and content schedule; (e) development of an multifaceted assessment and evaluation plan; (f) Item development and test formulation; and (g) test analysis.

Introduction section highlights the importance of intentional instructional design and discusses the components of reflective practices along with their benefits in attaining course objectives. A discussion is provided on the available teaching models and teaching and learning styles. Each of these has specific purpose and reason to be used under certain circumstances during a course delivery. Students learn different ways and it is a good idea to consider as many techniques as possible to address the need of majority of the student body.

The paper also discusses the Dale's cone of learning along with Bloom's traditional and revised taxonomy. Dale's cone of learning illustrates the importance of active learning to achieve higher retention of knowledge, while Bloom's taxonomy provides classification of levels

of intellectual behavior important in learning. Bloom identified six levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order which is classified as evaluation. For course design process it is important for a teacher to design a course with attaining highest level as possible for each student learning objectives. For the Bloom's revised taxonomy the former six categories were changed from noun to verb forms. The reasoning behind this is that the taxonomy reflects different forms of thinking and thinking is an *active* process. Another important issue considered was ABET outcomes that is a requirement for a course within an ABET accredited program.

A set of student learning objectives have been developed while addressing all the issues involving teaching models, teaching and learning styles, Dale's cone of learning, Bloom's traditional and revised taxonomy. This is one of the major steps in course design process. This was followed by development of course outlines with various pre-requirements, course priorities, and content schedule. The content schedule provides a detailed planning with day-to-day map considering each course topics along with corresponding teaching and learning models, learning styles, bloom's learning level, and Dale's cone of active learning.

Assessment is another major part of the course development process and to address this issue a comprehensive assessment plan has been developed. This is important in that sense that evaluating students learning is a major and one of the most difficult parts of course implementation process. It is important to include as many assessment tools as possible to provide broader picture of learning. The plan includes: observation, open-ended tests, objective tests, mapping, and performance assessment.

The last part of the course development process includes the development of performance assessment projects, test item development for objective tests, and test analysis. Three performance assessment projects have been developed along with their rubrics that are to be administrated at various stages of the course delivery. The developed items for the objective tests are in the category of short answer, multiple choices, true-false, and matching. The test analysis allows a faculty to: determine whether an item functions as it was intended, feedback to student about their performance and as a basis for classroom discussion, feedback to the faculty about students' difficulties, areas for curriculum development, and revising the assessment tasks and improving item-writing skills. A sample test analysis is provided to demonstrate the process.

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Appendix-A: Content Schedule and Styles, Models, Bloom's Analysis, Dale's learning.

Week		**Content Topic**	Content Source	Teaching Style	Learning Style	Teaching Model	Dale's Cone	Bloom's Traditional	Bloom's Revised
1	**1**	**1. <u>Number Systems</u>** Digital and Analog Systems (day-1) Number Systems in use (day-1) Number base conversations (day-1)	Text	A and B	CR and AR	Progressive Part Method, Lecture, and Graphic organizers	Active and Passive	Knowledge	Understand
1	**2**	Octal and other base systems (day-2) **Complements (day-2)**	Text	A and B	CR and AR	Progressive Part Method, Lecture, and Graphic organizers	Active and Passive	Comprehension	Understand
2	**1**	**2. <u>Logic Gates</u>** Basic Logic gates (day-1) The EXOR and EXNOR gates (day-1)	Text	A and B	CR and AR	Progressive Part Method, Lecture, and Graphic organizers, Concept attainment	Passive	Comprehension	Understand
2	**2**	Fixed function logic gates (day-2) Digital logic IC families (day-2) Realization of various gates from different kinds (2)	Text	A and B	CR, AR, and AA	Lecture, and Concept attainment	Active and Passive	Application	Apply
3	**1**	**3. <u>Boolean Algebra and Logic Simplification</u>** Boolean operations and expressions Laws and rules of Boolean algebra	Text	A and B	AR	Lecture, Graphic organizers	Active and Passive	Knowledge	Understand
3	**2**	De Morgan's Theorems Boolean analysis and logic circuits Standard forms of Boolean expressions	Text	A and B	AR and CR	Lecture, Graphic organizers	Active and Passive	Comprehension	Understand
4	**1**	The map method Two, three, four variable method	Text and Slides	A, B, and C	AR and AA	Lecture and Progressive part method	Active and Passive	Application	Apply
4	**2**	Product of Sum expression and design Sum of products and	Text	A and B	AR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply

		design alternatives NAND-NOR implementations							
5	**1**	**4. <u>Combinational Logic</u>** Design Procedure Analysis techniques	Text and slides	A and B	AR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Analysis	Analyze
5	**2**	Adders (Half and Full)	Text and slides	A and B	AR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Analyze
6	**1**	Binary adder Carry look ahead adder	Text and slides	A and B	AR and AC	Lecture, Inquiry, and Graphic organizers	Passive	Application	Apply
6	**2**	Binary subtractor Decimal adder	Text and slides	A and B	AR and AC	Lecture, Inquiry, and Graphic organizers	Passive	Application	Apply
7	**1**	Binary multiplier	Text and slides	A and B	AR and AC	Lecture, Inquiry, and Graphic organizers	Passive	Application	Apply
77	**2**	Magnitude comparator	Text and slides	A and B	AR and AC	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
8	**1**	**5. <u>MSI and PLD components</u>** Decoders and encoders	Text and slides	A and B	AR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
8	**2**	Multiplexers and demultiplexers	Text and slides	A and B	AR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
9	**1**	Programmable Logic Array	Text	A	AR and CR	Lecture and Graphic organizers	Active and Passive	Comprehension	Understand
9	**2**	Multilevel gates and their use in design procedures	Text and slides	A and B	AR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
10	**1**	**6. <u>Sequential Logic</u>** Flip-Flops (SR, JK, D, T)	Text and slides	A and B	CR, AR, and AC	Lecture, Inquiry, and Graphic organizers	Active and Passive	Comprehension	Understand
10	**2**	Flip-Flops (SR, JK, D, T)	Text and slides	A and B	CR and AC	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
11	**1**	Characteristic equations and excitation tables	Text and slides	A and B	CR, AR, and AC	Lecture, Inquiry, and Graphic organizers	Active and Passive	Analysis	Analyze
11	**2**	Clocked sequential circuits	Text and slides	A and B	AR and AC	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
12	**1**	State reduction assignment	Text and slides	A and B	CR and AC	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply

12	**2**	State reduction assignment	Text and slides	A and B	CR and AC	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
13	**1**	**7. <u>Application of Sequential Logic</u>** Design of counters using flip-flops	Text and slides	A, B, and C	CR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
13	**2**	Design of counters using flip-flops	Text and slides	A, B, and C	CR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Analysis	Analyze
14	**1**	Registers	Text and slides	A, B, and C	CR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
14	**2**	Counters	Text and slides	A, B, and C	CR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Application	Apply
15	**1**	Memory systems (RAM and ROM)	Text and slides	A, B, and C	CR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Comprehension	Understand
15	**2**	Memory decoding	Text and slides	A, B, and C	CR and CA	Lecture, Inquiry, and Graphic organizers	Active and Passive	Knowledge	Understand

<u>Appendix-B</u>: Mapping of SLOs with Bloom's cognitive process dimension

ABET/TAC Learning Outcomes	**Bloom's Knowledge Dimension**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
			Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
A. Mastery of knowledge, techniques, skills, modern tools of disciplines.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge	**1. To examine the components of a digital system.** a. To contrast between analog and digital signals b. To classify binary digits, logic levels, and digital waveforms c. To compare basic logic operations d. To categorize fixed function integrated circuits e. To interpret the operation of simple digital systems						
		2. To examine the structures for various number systems. a. To distinguish between various parts of number systems. b. To examine the counting in binary, octal, decimal, and octal.	 	 	 			
		3. To distinguish the conversion methods for various number systems. a. To convert between binary and decimal b. To convert between binary and hexadecimal c. To convert between binary and octal						
		4. To perform different binary arithmetic operations: addition, subtraction, 1's complement, 2's complement, and signed numbers. a. To examine the basic rules involving each of the operations. b. To use the rules to perform each of the operations.						
		5. To examine the operation and use of various						

ABET/TAC Learning Outcomes	Bloom's Knowledge Dimension	Student Learning Objectives	Bloom’s Cognitive Process Dimension					
			Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
		logic gates with different input patterns: AND, OR, and NOT, NAND, NOR, XOR and XNOR. a. To develop the truth tables of various logic gates using established rules. b. To use the truth tables to identify output pattern of a logic gate for a given set of input. c. To predict output logic levels for a pulse input pattern. d. To recommend the use of appropriate logic gate(s) for a given application. **6. To analyze the properties of fixed-function logic integrated circuits (IC): Complementary Metal Oxide Semiconductor (CMOS) and Transistor-Transistor Logic (TTL).** a. To identify various supply voltage and power requirements for CMOS and TTL ICs. b. To analyze the generic numbering convention for CMOS and TTL ICs. c. To classify common logic gate ICs according to their standard identifier digit. d. To examine the logic gate configuration within an IC. e. To compare alternative logic symbols for representing logic gates while drawing a circuit diagram. f. To examine the voltage values for input output logic levels for CMOS and TTL ICs. **8. To use Laws and Rules of Boolean algebra and DeMorgan’s Theoerms for manipulating Boolean expressions.** a. To use the commutative, associative, and distributive laws to manipulate Boolean expressions.	 	  	 			

ABET/TAC Learning Outcomes	Bloom's Knowledge Dimension	Student Learning Objectives	Bloom’s Cognitive Process Dimension					
			Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
		b. To examine the use of Boolean rules while manipulating Boolean expressions. c. To use DeMorgan’s Theorems for manipulating Boolean expressions. d. To adapt the Boolean laws, Boolean rules, and DeMorgan’s Theorems while minimizing Boolean expressions.						
		9. To analyze digital logic circuits using Boolean algebra. a. To develop a Boolean expression for a given logic circuit. b. To evaluate a Boolean expression and prepare a truth-table for the logic circuit. c. To demonstrate the use of Boolean algebra while minimizing Boolean expressions.						
		12. To minimize logic expressions using Karnaugh map (K-map). a. To develop K-maps with different size of input variables (1 to 4). b. To map SOP expressions on K-maps. c. To develop minimized expressions from K-maps.. d. To construct K-map from a non-structured SOP expression.						
		15. To evaluate the properties of Latches, Flip-Flops, and timers. a. To contrast between Latches and Flip-Flops. b. To evaluate the properties of edge-triggered J-K Flip-Flop. c. To evaluate the properties of edge-triggered D Flip-Flop. d. To evaluate the properties of edge-triggered S-R						

ABET/TAC Learning Outcomes	Bloom's Knowledge Dimension	Student Learning Objectives	Bloom's Cognitive Process Dimension					
			Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
		Flip-Flop. e. To utilize the asynchronous Preset and Clear inputs of Flip-Flops. f. To examine the operating characteristics of Flip-flops, such as- propagation delay times, set-up time, hold time, Maximum clock frequency, Pulse width, and Power dissipation. g. To compare the properties of commercially available Flip-Flop ICs.						

Appendix-C: Prerequisites in terms of science foundation, mathematics foundation, and communication skills.

SLOs **Pre-requisite**

	Science(s) Foundation Required	**Mathematics Foundation Required**	**Communication Foundation/ Skills Required**
1. Number Systems Digital and Analog Systems Number Systems in use Number base conversations Octal and other base systems Complements	Electricity and magnetism Semiconductor and its properties in relation to electronics.	Basic algebra	Ability to comprehend, analyze, and interrogate critically
2. Logic Gates Basic Logic gates The EXOR and EXNOR gates Fixed function logic gates Digital logic IC families Realization of various gates from different kinds	Series and parallel circuit philosophy Laws and theorems involving electricity and magnetism Semiconductor and its properties in relation to electronics.	Basic algebra Logic	Ability to comprehend, analyze, and interrogate critically
3. Boolean Algebra and Logic Simplification Boolean operations and expressions Laws and rules of Boolean algebra De Morgan's Theorems Boolean analysis and logic circuits Standard forms of Boolean expressions The map method Two, three, four variable method Product of Sum expression and design Sum of products and design alternatives NAND-NOR implementations		Linear algebra	Quantitative and qualitative reasoning Use of resources
4. Combinational Logic Design Procedure Analysis techniques Adders (Half and Full) Binary adder Carry look ahead adder Binary subtractor Decimal adder Binary multiplier Magnitude comparator		Linear algebra	Quantitative and qualitative reasoning Use of resources including technology.
5. MSI and PLD components Decoders and encoders Multiplexers and demultiplexers Programmable Logic Array Multilevel gates and their use in design procedures	Digital signal properties	Linear algebra	Quantitative and qualitative reasoning Use of resources including technology.

6. Sequential Logic Flip-Flops (SR, JK, D, T) Characteristic equations and excitation tables Clocked sequential circuits State reduction assignment	Digital signal properties	-	Quantitative and qualitative reasoning Use of resources including technology.
7. Application of Sequential Logic Design of counters using flip-flops Registers Counters Memory systems (RAM and ROM) Memory decoding	Digital signal properties	-	Quantitative and qualitative reasoning

Appendix-D: Course topics with priority levels.

Note: E- essential; P- possible to escape; NE- not essential

1. Digital Concepts
- Understanding of digital systems (E)
- Binary digits, logic levels, and digital waveforms (E)
- Basic logic operations (E)
- Fixed function ICs (E)
- Digital system applications (E)

2. Number Systems
- Anatomy of number systems and different number systems (E)
- Number base conversations between common number systems (E)
    - Binary, octal, decimal, and hexadecimal
- Complements- 2s (P)
- Binary addition (E)
- Binary subtraction (P)

3. Logic Gates
- Concept of logic gates (E)
- Basic Logic gates (AND, OR, NOT, NAND, NOR) (E)
- EXOR and EXNOR gates (E)
- Fixed function logic gates and digital logic IC families (E)
- Basic characteristics of IC families (P)
- Realization of various gates with other kinds (NE)

4. Boolean Algebra and Logic Simplification
- Boolean operations and expressions (E)
- Laws and Rules of Boolean algebra (E)
- De Morgan's Theorems (E)
- Boolean expressions for logic circuits (E)
- Minimization of Boolean expressions using Laws and Rules of Boolean algebra and De Morgan's Theorems. (P)
- Minimization of Boolean expressions using K-map method (upto 4 variables) (E)
- Standard forms of Boolean expressions (P)
- Product of Sum expression and design (P)
- Sum of products expression and design alternatives (NE)

5. Combinational Logic Analysis
- Basic combinational logic circuits (E)
- Concept of digital systems design (E)
- Detailed design procedure (E)
- Analysis of digital systems (E)
- Universal property of NAND and NOR gates (P)
- Logic operations with pulse inputs (NE)

6. Functions of Combinational Logic
- Adders (Half and Full) (E)
- Carry look ahead adder (NE)
- Binary subtractor (NE)
- Binary multiplier (P)
- Magnitude comparator (E)
- Decoders and encoders (E)
- Multiplexers and demultiplexers (E)
- Programmable Logic Array (NE)
- Multilevel gates and their use in design procedures (NE)

7. Latches, Flip-Flops, and Timers

- Latches (E)
- Flip-Flops (SR, JK, D, T) (E)
- Characteristic equations and excitation tables for each types (E)
- Clocked sequential circuits (E)
- Flip-flop applications (E)
- One shot (NE)
- The 555 timer (NE)

8. Counters

- Asynchronous counters (E)
- Synchronous counters (E)
- Up-down counters (NE)
- Counter applications (E)

9. Shift Registers

- Basic shift register functions (E)
- Serial In/Serial out shift registers (E)
- Serial In/Parallel out shift registers (NE)
- Parallel In/Serial out shift registers(NE)
- Parallel In/Parallel out shift registers (E)
- Bidirectional shift registers (NE)
- Shift register applications (E)

Appendix-E: Course topics, Teaching model and Teaching styles, Learning styles, Bloom's knowledge level, Dale's learning, and topics.

Week Obj	TM TS	LS	B	D	Topics/Lab Activities & Due Dates	TM TS	LS	B	D	Topics/Lab Activities & Due Dates
1 8/28	**Inductive thinking / F**	**Assimilating**	Comprehension		Digital Concepts	**Direct instruction and inductive thinking/F**	Assimilating	Application	Receiving /participating	Number Systems
2 9/4	**Concept attainment , and Direct instruction / B, F**	Assimilating	Comprehension	Receiving / participating	Number Systems	**Concept attainment and direct instruction / B, F**	Assimilating	Comprehension	Receiving / participating	Logic Gates
3 9/11	**Concept attainment, and Direct instruction / A**	Assimilating	Application	Receiving / Participating	Logic Gates	**Concept attainment and direct instruction / B**	Assimilating	Comprehension / application	Receiving / Participating	Logic Gates
4 9/18	**Inductive thinking / B, D**	Assimilating	Application	Receiving / Participating	Logic Gates	**Direct instruction, Content attainment, and Partners in learning / A, B, H**	Assimilating / Diverging	Comprehension	Receiving / Participating	Boolean Algebra and Logic Simplification **Performance Test-1**
5 9/25	**Content attainment, and Inductive thinking / B, D**	Assimilation	Application	Receiving / Participating	Boolean Algebra and Logic Simplification	**Direct instruction, and Content attainment / A, B**	Assimilating	Comprehension	Receiving / Participating	Combinational Logic Analysis
6 10/2	**Inductive thinking, and Content attainment / B, D**	Assimilation	Application	Receiving / Participating	Combinational Logic Analysis	**Inductive thinking, and Content attainment / B, D**	Assimilation	Application	Doing	Combinational Logic Analysis
7 10/9	**Direct instruction, and Inductive thinking / A, B**	Assimilating	Comprehension	Visual receiving	*Functions of Combinational Logic*	**Inductive thinking, and Content attainment / B, D**	Assimilation	Application	Receiving / Participating	*Functions of Combinational Logic*
8-10/16 MT	**Mnemonics, Inductive thinking, and Content attainment / B, D**	Assimilation	Application	Receiving / Participating	*Functions of Combinational Logic*					**MIDTERM**

9 10/23	**Inductive thinking / B, D**	Assimilation	Application	Doing	*Functions of Combinational Logic*	**Inductive thinking, Partners in learning, Group investigation / B, D, H**	Assimilation / Diverging	Application	Doing	*Functions of Combinational Logic* **Performance Test-2**
10 10/30	**Direct instruction, and Inductive thinking / A, B**	Assimilating	Comprehension	Visual receiving	Latches, Flip-Flops, and Timers	**Content attainment and Inductive thinking / B, D**	Assimilation	Application	Receiving and participating	Latches, Flip-Flops, and Timers
11 11/6	**Content attainment and Inductive thinking / B, D**	Assimilation	Application	Receiving and participating	Latches, Flip-Flops, and Timers	**Direct instruction and Content attainment / A, B**	Assimilation	Comprehension	Visual Receiving and Participating	Counters
12 11/13	**Inductive thinking and Content attainment / B, D**	Assimilation	Comprehension	Receiving and Participating	Counters	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Visual Receiving and Participating	Counters
13 11/20	**Direct instruction and Content attainment / A, B**	Assimilation	Comprehension	Visual Receiving and Participating	Shift Registers					**11/23 THANKSGIVING**
14 11/27	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Receiving and Participating	Shift Registers	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Visual Receiving and Participating	Shift Registers
15 12/4	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Receiving and Participating	Shift Registers	**Inductive thinking, Partners in learning, Group investigation / B, D, H**	Assimilation / Diverging	Application	Doing	**Performance Test-3**
16-2/11 FE	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Receiving and Participating	Shift Registers					**Final Examination**

Appendix-F: Bloom's Learning Taxonomy – Analysis Chart for Assessment Components.

Assessment	**Knowledge**	**Comprehension**	**Application**	**Analyze**	**Synthesize**	**Evaluate**
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Midterm	X	X	X			
	8%	38%	54%			
Final	X	X	X			
	4%	35%	61%			
Performance test-1					X	X
					50%	50%
Performance test-2					X	X
					50%	50%
Performance test-3					X	X
					50%	50%
Homeworks		X	X	X		
		40%	30%	30%		
Concept map			X	X		
			40%	60%		

Appendix-G: Performance Assessment Project.

Content Standard

ABET Outcomes:

A. Mastery of knowledge, techniques, skills, modern tools of disciplines.
B. Apply current knowledge and adapt to emerging applications of math, science, engineering, and technology.
D. Ability to apply creativity in the design of systems, components, or processes appropriate to program objectives.
E. Function effectively on teams.
F. Identify, analyze, and solve technical problems.
G. Communicate effectively in writing.
H. Communicate effectively orally.
I. Recognize the need for, and an ability to engage in life long learning
L. Commitment to quality, timeliness, and continuous improvement.

Student Learning Objectives

1. To examine the components of a digital system.
5. To examine the operation and use of various logic gates with different input patterns: AND, OR, and NOT, NAND, NOR, XOR and XNOR.
6. To analyze the properties of fixed-function logic integrated circuits (IC): Complementary Metal Oxide Semiconductor (CMOS) and Transistor-Transistor Logic (TTL).
7. To analyze the performance characteristics and parameters for logic gates and evaluate their significance in digital design.
8. To use Laws and Rules of Boolean algebra and DeMorgan's Theoerms for manipulating Boolean expressions.
9. To analyze digital logic circuits using Boolean algebra.
12. To minimize logic expressions using Karnaugh map (K-map).
13. To analyze digital systems using combinational logic.
14. To evaluate combinational logic circuits for commonly used digital functionalities: Half-adders and full-adders, parallel binary adders, comparators, BCD to decimal decodes, BCD to 7-segment decoders, encoders, multiplexers, and demultiplexers.
15. To evaluate the properties of Latches, Flip-Flops, and timers.
18. To design and study of counter applications using Flip-Flops.

1. Problem Statement

You are working with an industry that produces pharmaceutical pills. At some point, you are assigned to design a digital controller that will perform the following tasks:

a) Differentiate pills from one kind to another and direct them towards different parts of the facility
b) Count the pills of each type and bottle them with different bottle counts

[*The problem statement provides a general description of the system. You need to assume other details when developing the concept designs. Make sure to specify the assumptions at the very beginning of the project.*]

2. Task Description

During the project student needs to perform the following tasks:

2.1 Develop a number of concept designs with the given problem statement (*section 1 and your own assumptions*).

2.2 Pick one of the concept designs as your final design choice and elaborate its working functionalities with details.

2.3 Develop detailed design and identify generic components that need to be used for the project implementation.

2.4 Research on identified components and justify their selection considering the design factors (provided in section 3) along with the problem statement and your own assumptions.

2.5 Complete the design with selected components and develop a complete drawing along with a description of its operation. [*please keep in mind that your design should contain all the information so that one can assemble the system without any enquiry*]

2.6 Evaluate the design in terms of achieving the identified functionalities [section 2.2].

2.7 Propose alternative designs/modifications that can be implemented to improve the current design.

3. Design factors that should be considered during the design process

The designing the project you should consider the following criteria:

a) Lowest cost possible
b) Minimum power consumption while fulfilling the design assumptions
c) Highest possible speed of operation as required by the system
d) Smallest physical size
e) System should stand assumed environmental conditions
f) System should be designed for return of investment for a reasonable period of time.

4. Deliverables

a) Written report describing all the project activities as described within this document.

5. Rubric

Attributes	C (79-70)	B(89-80)	A (100-90)	Marks
Concept designs and understanding of the problem	Demonstrate partial understanding of the problem: - Only two designs - Unclear design descriptions - Improper use of technical terms	Demonstrate understanding of the problem: - All three designs - Provided design descriptions and choose one as the final choice - Some use of technical terms	Demonstrate complete and clear understanding of the problem: - All three designs with clear description of the designs with proper diagrams and choose one as the final choice. - Proper use of technical terms	**5**
Research for specific component selection (considering the design criteria)	Collects very little information: - Information provided from only two sources - No review of collected information	Collects some basic information, most relates to the problem: - Information provided from three sources - Some review of the collected information	Collects great deal of information with proper analysis: - Information provided from three different sources - Complete review of the collected information	**25**
Complete Design	Basic design: - No or very little justification for selecting components - System diagram with little details	Moderate design: - Some justification for selecting components - System diagram with some details	Complete design: - Complete justification for selecting components - System diagram with complete details with an orderly manner	**35**
Evaluation	Limited evaluation: - Provide partial evaluation of the design with some description of the evaluation process - No suggestion of any modification	Full evaluation: - Provide an evaluation of the design with some description of the evaluation process - Suggest one possible modifications in the design in light of the evaluation outcome	Detailed evaluation: - Provide a detailed evaluation process for all the design outcomes - Review all the design decisions in terms of identified functionalities - Suggest few possible modifications in light of the evaluation outcome	**20**
Written report (A separate document is provided with a report sucture)	Report with some details: - Explain the project activities using texts, and few diagrams, and tables. - Very little use of technical terminologies - Little use of supplied report structure - Incorrect grammar and punctuations	Report with details: - Explain the project activities using texts, diagrams, and tables (as necessary) - Use of technical terminologies - Most use of supplied report structure - Minor grammatical mistakes	Elaborate report: - Explain the project activities with texts and lots of diagrams, and tables. - Use of technical terminologies - Complete use of supplied report structure - Good English and punctuations	**15**

An experiment in hands-on learning in engineering mechanics: statics

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Abstract

Students in an introductory engineering mechanics (statics) are randomly divided into two groups. Both groups receive identical instruction except for roughly once time per week, for the first half of the semester. During these exceptional sessions, one group is given hands-on manipulatives with which to solidify concepts, while the other group is not. The degree of learning is assessed with a midterm multiple choice concept test and midterm problem solving whose questions have multiple interconnected parts. Overall, the two groups show no notable difference in learning. However, when one looks at electrical engineering (EE) students and mechanical engineering (ME) students separately, it appears that the EE students benefit from the hands-on exercises, while the ME students might be better without.

1 Introduction

According to current understanding, we humans think, learn, and solve problems by making connections and associations to our previous experiences [3]. It follows that if one's first exposure to engineering concepts takes place by passively hearing it in a lecture or by reading it in a textbook, the experience may not be sufficiently significant or rich to build connections.

Hake [6] conducted a study of more than 6,500 students in 62 different introductory physics courses. He found that students taking interactive engagement (IE) courses had dramatically better conceptual understanding, compared to students taking traditional courses. Here, Hake defines "interactive engagement" (IE) courses as

> ... those designed at least in part to promote conceptual understanding through interactive engagement of students in heads-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors.

In Hake's study, "traditional" courses are those that make little use of IE methods. A partial list of other studies that corroborate and build upon Hake's findings include [9–11, 15, 20–22]. Some of these other results are even more dramatic. One particularly interesting study is that by Redish et al. [13] who show evidence that the gains derived from IE learning are due to the type of instruction rather than differences in time on task or the skills of individual instructors.

But how critical is the "hands-on" component of interactive engagement? In Section 2.2, we highlight multiple viewpoints expressed in the literature. Some researchers see hands-on activities as particularly effective techniques for developing conceptual understanding. Others, favoring a more axiomatic approach, see experimentation as a less important activity for learning. Herein, we describe an experiment in which we randomly divided a large introductory mechanics course

into two groups. One group was given objects that they can manipulate while they they learn and explore mechanics concepts. The other group learned via interactive engagement, but did not have the hands-on manipulatives. In this paper, we present differences in learning between the two groups. Some subsets of students appear to benefit form the hands-on activities while others do not.

The research was conducted as part of the College Initiative on Teaching and Learning (CITL) within the College of Engineering & Engineering Technology at Northern Illinois University. Selected faculty members from all four departments in the college participated in a series of workshops where they completely redesigned courses they were teaching, posed educational research questions associated with the classes, and designed experiments to answer those questions.

2 Modeling in Engineering Mechanics

Before describing the experiment and its results, it is instructive to characterize the nature of the engineering mechanics course that serves as our laboratory.

Like most mechanical engineering curricula throughout the country, we at Northern Illinois University (NIU) require undergraduates to take an introductory mechanics course from the physics department. Shortly afterward, students must take a two course sequence in "engineering mechanics" (statics and dynamics), taught by engineering faculty. Overlap between the physics course and the engineering courses is significant. Both the engineering and the physics courses cover vector arithmetic, Newton's laws of motion, impulse-momentum principles (linear and angular), and the work-energy principle. However, since these topics are so fundamental to mechanical engineering, many, if not most, of us find the overlap justifiable.

In the *engineering mechanics* courses, students often have to solve problems with multiple interconnected bodies. Typically, this makes the problems more difficult to solve, yet makes the problems more relevant to engineering. In our opinion, the most important contribution that the engineering mechanics courses make toward the undergraduates' education is the systematic engineering approach to modeling, analysis, and problem-solving that we try to inculcate into the students early in the curriculum. It is the same process that students will use later to study mechanics of materials, vibrations in mechanical systems, the dynamics of fluid systems, jet propulsion, and more.

To study the mechanics of machines and devices that engineers create, the engineer must first create a model of the object. In engineering mechanics, modeling is a process of abstraction in which real-world objects are represented by mathematical models amenable to rigorous analysis. Borrowing from Hestenes [7], we represent the two-step process schematically as shown in Figure 1.

The lowest level in the figure represents the real world itself, containing all the machines and devices that engineers create. The first step in the modeling process that we teach is to create a free body diagram (FBD). The FBD is a *graphical* representation of the physical object, depicting all the forces and moments acting on it. In creating the FBD, one usually has to make assumptions or approximations. For example, it is common to approximate real world objects as particles or as undeformable bodies. One might choose to ignore the weight of a component, or neglect friction. One may represent forces acting on a body as concentrated load applied to a single point. The forces that one draws on the FBD must always obey Newton's third law.

In the second step in the modeling process, we apply Newton's second law. Students translate the graphical model into a *mathematical* model. The set of equations that students derive express a relationship between known quantities given to them and unknown quantities that they wish to determine. This is "Level 2" in Figure 1.

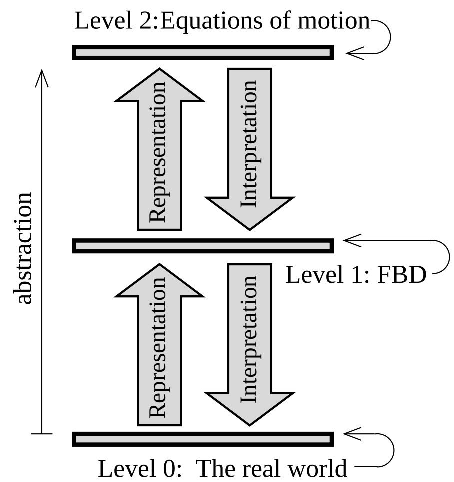

Figure 1: Schematic depiction of modeling process in engineering mechanics. Adapted from [7].

Assuming that one is able solve the equations in the mathematical model for the quantities of interest, one realizes the powerful analytical framework presented in Figure 1. Solution of the equations which reside in Level 2, corresponds to the "behavior" of the system depicted graphically in the FBD at Level 1. If the FBD is a good representation of the physical system, then the mathematical results shall closely predict the actual behavior (e.g. forces, accelerations) of the real-world system at Level 0. This process is a model for how even very complex engineering analysis works.

2.1 What Students *Don't* Understand in Statics

Statics is the first of the two engineering mechanics courses we teach. In this course, none of the systems accelerate. Setting $\boldsymbol{a} = \mathbf{0}$ in Newton's second law, converts the equations of motion in to form of ordinary differential equations (ODEs) into equilibrium equations in the form of algebraic equations. Often the algebraic equations are linear. As a consequence, they are relatively easy to solve. Thus when students have difficulties, the difficulties lie in creating an appropriate free body diagram or in deriving the equilibrium equations – levels 1 and 2 of Figure 1.

The assertion is backed up by a recent paper by Streveler et al. [19]. They report initial findings of a Delphi study on engineering mechanics concepts that students find most difficult. The most difficult statics concepts on the list are: 1. static indeterminacy; 2. external vs. internal forces; 3. isolating a body from its surroundings; 4. couples; 5. static friction; 6. importance of signs on forces; 7. distributed forces; and 8. two force members. According to the study, item 1 is the most difficult among concepts in the list, while items 2 through 7 all tie for next most difficult. All these difficult concepts lie within the modeling phase of the problem solving process. (Although items 1 and 5 may also reside in the solution phase.) Interesting, but perhaps not surprising to those who teach statics, is that most of the difficult concepts are related to drawing appropriate free body diagrams.

Also, it is worth noting that the difficult concepts are not natural concepts that the average person recognizes as he/she casually observes the physical world. To internalize the concepts, students must engage in deep thought, possibly supplemented by experimentation. Furthermore, students must recognize and abandon any misconceptions they have.

2.2 Perspectives on Interactive Engagement

Most engineering instruction is deductive. Theories and general principles are taught first; applications then follow. The practice appears to support a widely held misconception in engineering education practice that knowledges is something that can be simply transmitted from expert to novice.

Decades of research, however, supports an alternative model of learning (*constructivism*) in which knowledge is constructed rather than absorbed. Within this framework, knowledge is gained only after the new information filters through a student's mental structures that "incorporate the student's prior knowledge, beliefs, preconceptions, misconceptions, prejudices, and fears."[12] New information that is consistent with the existing mental structures is more likely to be integrated. Contradictory information, or information that simply does not connect with the existing mental structures, more often passes through without being incorporated into the knowledge base.

From this perspective, Prince and Felder [12] argue that engineering instruction should be inductive. Educators should start with applications that provide meaning and context to students; then we can build the theory on top of applications where the questions "why?" and "how?" can be answered readily. Prince and Felder define the term *inquiry learning* as instruction that uses questions and problems to provide context for learning, and which does not fall into related but more restrictive categories such as problem-based learning, project-based learning, case-based learning, discovery learning, and just-in-time teaching [12].

2.2.1 Instruction Approach #1: Hands-On, Heads-On. Laws et al. [9] provide a somewhat narrower working definition of inquiry-based learning in their studies of student learning in physics. Primary elements of their instructional approach are listed in Table 1.

1.	Use peer instruction and collaborative work.
2.	Use activity-based guided inquiry curricular materials.
3.	Use a learning cycle beginning with predictions.
4.	Emphasize conceptual understanding.
5_1.	Let the physical world be the authority.
6.	Evaluate student understanding.

Table 1: Elements of inquiry based learning. Adapted from [9].

We call specific attention to item 5_1 of the list. In this instructional model, the instructor is *not* the authority. Neither is the textbook, nor the answers in the back of the textbook. Instead, students have access to a physical system that they can probe, test hypotheses, and verify understanding of particular questions they are asked. In this instruction model, students' small-scale experiments play a key role in concept acquisition.

Steif and Dollár [18] and Thacker et al. [20] espouse a similar approach of "hands-on, heads-on" learning. All these studies yield rather dramatic improvements in learning compared to students who take traditional lecture-based courses.

In a similar approach, Thornton and Sololoff [21] when digital simulations are used as a substitute for the real world. Learning results are similarly impressive.

2.2.2 Instruction Approach #2: Hands-Off, Heads-on As an alternative to hands-on approach described in the previous section, we also consider a second instruction model motivated by a perspective proffered by Hestenes [7]. He argues that the best way to teach mechanics, and physics in general, is to make a sharp distinction between the (real) "Physical World" and the

(conceptual) “Newtonian World.” The Newtonian World (upper two levels of Figure 1) is where mechanics/physics lives. It is defined by a set of axioms: the axioms of geometry and Newton’s laws of motion.

At first glance, Hestenes’s approach may appear rigidly deductive. The axioms or laws are presented upfront; then it is up to students to apply them to a litany of problems. However, Hestenes compares his approach to that of playing a game. Like chess, Hestenes’s Newtonian modeling game has relatively few clearly defined rules which can lead to a rich set of outcomes. Unlike chess, the modeling game is not competition between players. Rather, it is more like a puzzle in which students are challenged to create representations of the physical world that are consistent with the Newtonian axioms. Students are encouraged to consider multiple representations, to test them, and to recognize patterns. In this instruction approach, students do *not* use experiments to acquire physical concepts. Instead, the role of experiments, if any, is to *validate* Newtonian models.

As Hestenes describes [7], the instruction approach is well aligned with the constructivist model of learning. In the current study, we couch a form of the Newtonian modeling game in an inquiry learning framework, as defined by Prince and Felder (See Section 2.2). Specifically, we adopt the instructional approach outlined in Table 1, with one exception. In place of item 5_1, we substitute the following:

5_2.	Let the axioms of mechanics be the authority.

In many ways this second instruction approach is similar to those found in typical textbooks, but placed in an instructional setting that promotes interactive engagement.

3 Research Question and Methods

Herein, we report on a research project in which we test the two modes of teaching outlined in Sections 2.2.1 and 2.2.2. To keep the nomenclature simple, we will refer to these two instruction models as the “hands-on” and “hands-off” approaches. Specifically, we pose the following question:

- In an introductory engineering mechanics (statics) course, which teaching strategy is more effective on learning as reflected in midterm and final examinations: hands-on or hands-off.

In Section 3.1, we provide a more detailed description of the hands-on and hands-off activities.

Before the first day of class, we randomly assigned students registered for the course into two groups. One group would periodically receive the hands-on instruction, while the other received hands-off instruction. Students who registered for the course late, were assigned to a relatively small third group. Although the third group received “hands-off” instruction, the performance of these students was not included in the statistics of the “hands-off” group. Over the semester, a handful of students (distributed roughly evenly over all groups) dropped the course. Their data are not included in the analysis also.

In the first half of the semester, we periodically split the class. The two groups met in separate classrooms and received different instruction. The split occurred about once per week on average, usually coinciding with the introduction of new concepts. On other days, the entire class met in the same room. On these days, we more often focused on problem-solving exercises similar to homework assignments in common textbooks (e.g. [1, 8, 14]).

The first few times we split the class, we also split the instructors. In other words, the teaching assistant and professor switched rooms half way through the class period. After a few attempts, we found this to be too disruptive to the flow of the class. For the remainder of the split sessions, the teaching assistant and professor alternated between groups on separate days.

During the split sessions, and also during many of the combined sessions, students worked in small groups of three or four students. The small groups were assigned at the beginning of the semester with the goal of achieving diversity in academic major, and number of years at the university.

The periodic split sessions continued until we administered the midterm exams. Afterward, both groups received common instruction. There was a hands-on project in which all students participated in designing and building trusses. Also the instructor, rather than students, performed demonstrations in the second half of the course.

3.1 Student Activities

3.1.1 A pulley problem. The differences between the two teaching approaches may be illustrated through an example. At the end of the first week of class, we ask students to analyze the system shown in Figure 2.

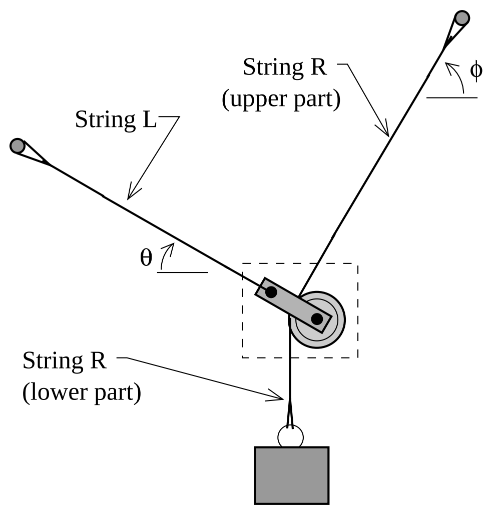

Figure 2: A pulley problem.

Both groups of students are asked to examine how the tensions in String L (T_L), the upper part of String R (T_{R_U}), and the lower part of String R (T_{R_L}) change as one varies the angle ϕ. Also, students are asked to investigate what happens to angle θ as one changes ϕ.

The investigation should be described as a preliminary study, aimed at getting students engaged in a problem before the standard textbook analysis is performed in class. At the time students receive the assignment, we had covered Newton's laws in lecture, and the meaning of "force." Furthermore, we had completed an in-class exercise in which students studied the nature of tension in a straight rope without a pulley. Students found that tension is essentially constant along the length of a light-weight string. Tension varies linearly along heavy, hanging chains.

Both groups begin the exercise by hypothesizing. Students sketch plots of T_L, T_{R_U}, T_{R_L}, and θ, separately, as functions of ϕ. Based on previous activities, students were generally able to recognize that T_{R_L} should equal the weight of the block, regardless of the angle ϕ. Students use their intuition or prior knowledge to form the other hypotheses.

Next, they explore. We give students in the "hands-on" group string, springs (for measuring tension), a pulley, protractor, ruler, and block to carry out the physical experiment. Plotting the tensions and angle θ as functions of ϕ, students observe trends. Specifically, they *discover* that T_{R_U} does not change with ϕ; it is always equal to the weight of the block.

The "hands-off" group does not get hardware to manipulate. Instead they are asked to consider the forces acting on the pulley (assuming one can neglect the weight of the pulley). Students are asked to depict the three forces on the pulley graphically as indicated Figure 3a. Magnitudes and

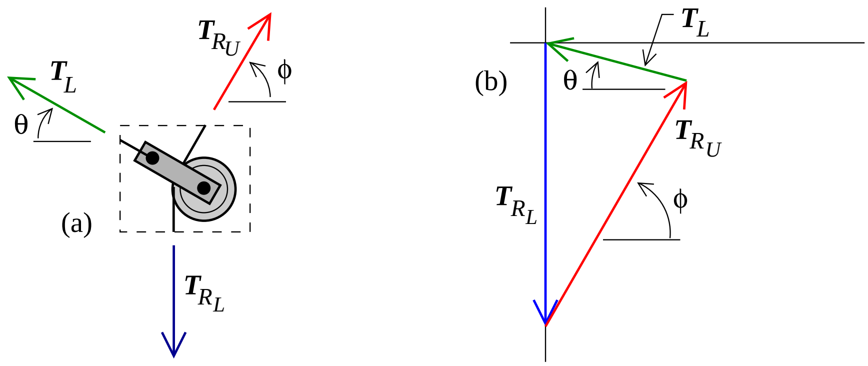

Figure 3: Vector addition of external forces, demonstrating equilibrium.

directions of the forces are represented by lengths and directions of the arrows. In order for the pulley to remain in equilibrium, all the forces must balance out. Therefore, when arranged head-to-tail the three arrows close to form a triangle. Students were told to *assume* that the tensions in the upper and lower parts of String R are identical: $T_{R_U} = T_{R_L}$. (Since this exercise occurs before discussion of moments, it is not possible to derive the result from first principles.) Armed with a ruler, protractor, pencil, and paper they are able to draw the force triangles (Figure 3b) and discover how the system responds to changing ϕ.

Before returning to the next meeting of the course, students in both groups had to use their findings to compare and evaluate competing designs for a box-hoisting system. In the next meeting, we solved the problem in a more traditional manner in which forces are decomposed into horizontal and vertical components, and equilibrium equations are formulated and solved.

3.1.2 Geometry of Vector Decomposition In the next split-class exercise, students were asked to consider a 200-pound person standing on a scale. When the scale lies flat on the floor, it reads 200 pounds. What does the scale read when it lies on an inclined surface? What is the scale reading as a function of angle ϕ in Figure 4?

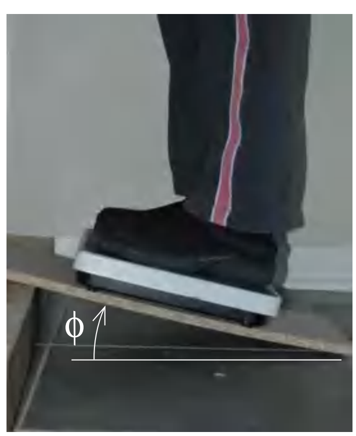

Figure 4: Bathroom scale used in a vector decomposition activity.

Again, we ask students to form a hypothesis based on hand sketches and/or intuition. Then

they get to work. While students in the "hands-on" group work on the problem, they have access to a bathroom scale, a board and some blocks that they use to check their intuition and calculations. Students in the "hands-off" group employ only the analysis techniques via pencil and paper taught in the course. To verify their results, students in the hands-off group are encouraged to perform sanity checks in which they confirm whether their answers make sense when $\phi = 90°$, $0°$, and $-90°$.

3.1.3 Exploring Moments About a week later, after introducing students to moments, students were asked to consider a set of problems regarding the 'F'-shaped frame shown at the top of Figure 5. The frame lies in a horizontal plane and is pinned so that it is free to rotate about point

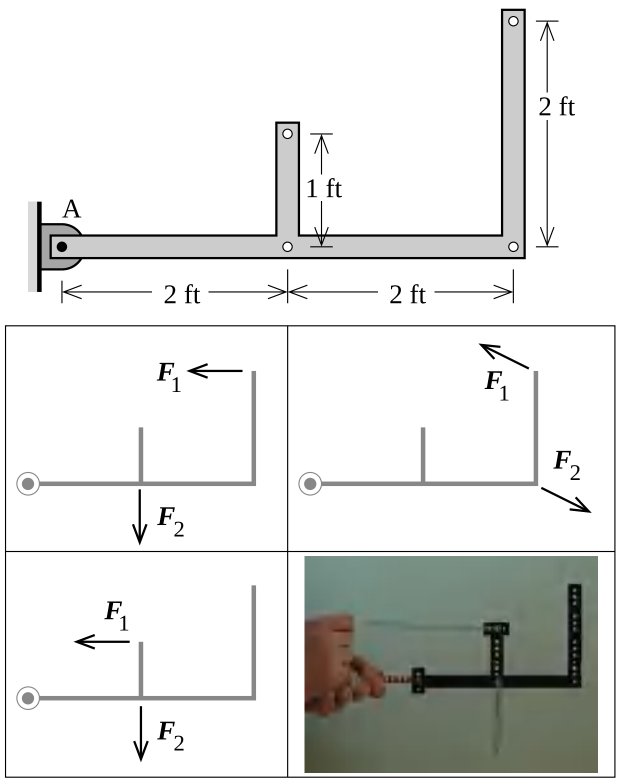

Figure 5: 'F'-shaped frame for studying moments.

A. We asked the students nine questions, three of which are shown in the bottom half of Figure 5. Under the loading conditions shown, students are told that the system is in equilibrium. Then they are asked which of the following are true: (A.) $0 < |\boldsymbol{F}_1| < |\boldsymbol{F}_2|$; (B.) $0 < |\boldsymbol{F}_1| < |\boldsymbol{F}_2|$; (C.) $0 < |\boldsymbol{F}_1| = |\boldsymbol{F}_2|$; or (D.) either $|\boldsymbol{F}_1|$ or $|\boldsymbol{F}_2|$ *must* be zero.

Students in the "hands-on" group received physical representations of the 'F'-shaped frames as depicted in the bottom right corner of Figure reffig:Fframe. They can apply the forces by attaching springs to the frame and pulling. One can *feel* which force is bigger and *see* which is bigger by observing the relative lengths of the stretched springs.

Again, the "hands-off" group does not get to use the manipulatives. Instead, they must solve the problems by intelligent decomposition of position and force vectors and by the principle of transmissibility.

3.1.4 Tipping criterion for crane. One of the goals of elementary mechanics courses is to develop students' problem solving skills. Consider the crane shown in Figure 6a. At some point in the course, students become relatively proficient at performing straightforward force calculations.

For a given crane load, for example, one can calculate the support forces that the ground exerts on the tracks of the crane.

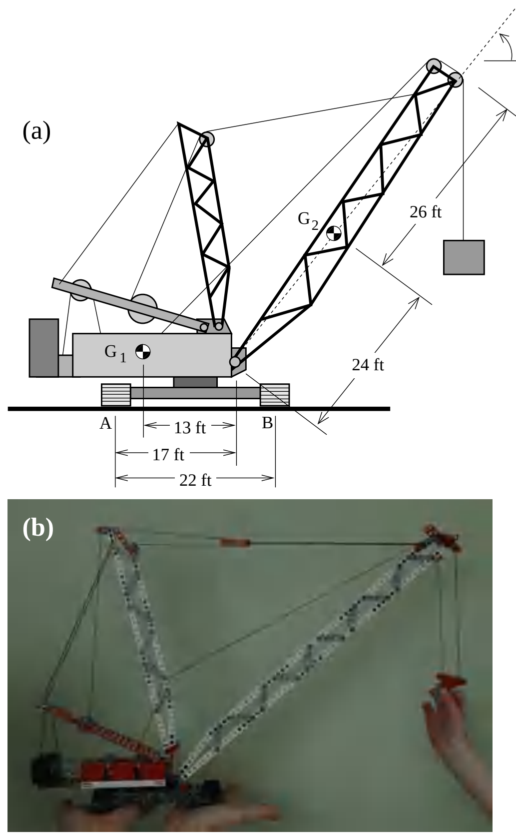

Figure 6: Tipping crane activity.

One can exercise students' higher order thinking skills, by rephrasing the problem. For example, we asked students to calculate the minimum load that will cause the crane to tip over. Novices are often confounded by such problems. They often attempt to incorporate the dynamics of the crane tipping into their formulation. Of course, the proper approach is to formulate it as a statics problem, and then calculate the load for which the assumption of it being a statics problem is on the verge of being violated. In this problem the violation occurs when the normal force on the cranes track at B becomes zero.

When solving the problem, students in the "hands-on" group get a toy crane made from Legos$^{\text{TM}}$to play with. If or when a small group of students got stuck, the instructor guided them through a simple hands-on experiment. One student lets the crane rest in his or her hands as shown in Figure 6b. One track rests in the student's right hand, while the other track rests in the left. Without any load, the crane's weight is distributed roughly evenly between the two hands.

When another student pulls down on the hook, slowly increasing the load, the student holding crane *feels* the force one hand increase while the force on the other hand decreases. The student observes that the normal force vanishes as one of the tracks lifts off his or her hand, and the crane begins to tip. The tipping criterion to put in the mathematical formulation becomes clear.

Students in the "hands-off" group do not get cranes. When they run into trouble, the instructor guides small groups of students through a similar thought experiment in which they examine the solution of the static equilibrium equations as the load is slowly increased.

3.1.5 Design of a crane boom. In another in-class/split-session activity, we asked students to evaluate four crane designs, two of which are shown in Figure 7. For the two cranes shown in the figure, the one has the secondary boom, while the other does not. To figure out the purpose that the secondary boom serves, students are asked to investigate cable tensions in the two configurations. Again, students in the "hands-on" group are able to tinker with the Lego cranes while those in the "hands-off" group can not.

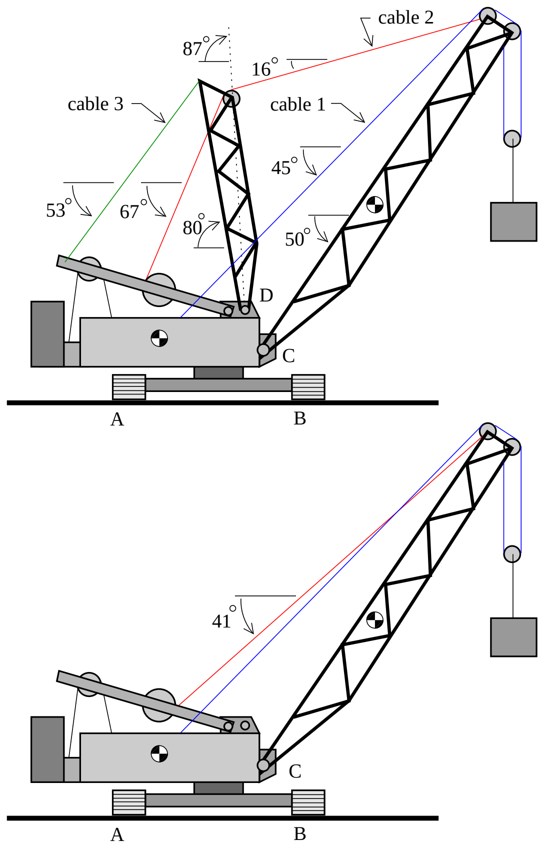

Figure 7: Different crane designs for students to evaluate.

3.1.6 A friction problem. One of the teaching objectives of the course is to introduce students to the static Coulomb friction model. In a class following an introduction to static friction, students were asked to consider the two problems depicted in Figure 8. In both problems, a cart-like device rests on an inclined plane. The cart has one set of wheels that are free to rotate; it has a skid which provides friction to keep the cart in place. In one problem, the cart is oriented so that the skid is downhill of the wheels. In the other, the skid is uphill. Students were asked to find the maximum angle ϕ for which cart will remain stationary on the surface. Many novices believe that the angle should be the same in both cases. After all, it is the same cart.

Students in the "hands-on" group are given a toy cart made from Legos™and ancillary equipment to try out the two case. Perhaps contrary to their preconceptions, students *see* that the configuration in 8a is able to remain stationary on a steeper slope. Then they perform analysis to explain the phenomenon. Again, students in the "hands-off" group must solve the problem starting from axioms.

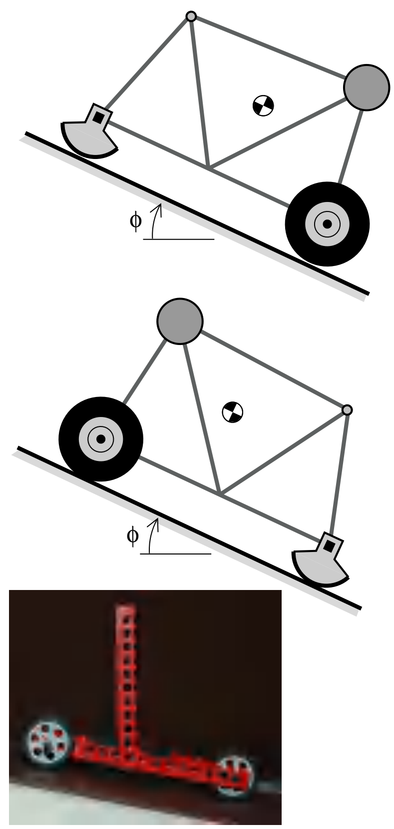

Figure 8: A static friction problem.

3.1.7 Static indeterminacy. In one of the split sessions, we ask students to find the three string tensions in the planar problem shown in Figure 9a. It looks similar to a problem we studied at the beginning of the semester, and they dive in. They are able to derive two equations which reflect horizontal and vertical force balances. They are unable to generate a third independent equation by taking a moment about any point. Thus, they are unable to solve for the three unknowns.

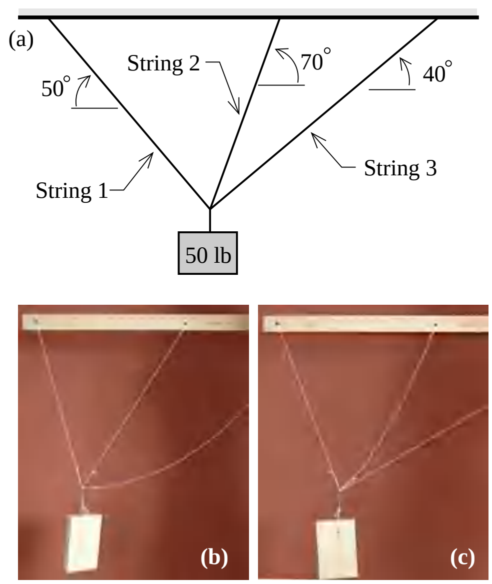

Figure 9: A statically indeterminate problem.

The problem is an example of static indeterminacy, and it is confusing to students. What seems like a well-posed problem has no solution; it should be possible to calculate tensions. We give students in the "hands-on" group materials with which they can create the three-string planar system. They quickly *discover*, that it is not easy to create. If string 2 is a couple millimeters too short, then string 3 goes slack (Figure 9b). Likewise, if string 3 is a couple millimeters too short, string 2 goes slack (Figure 9c). Therefore, it is not a well-posed problem. The problem becomes well-posed, however, when one replaces one or more of the strings by springs that stretch. The tensions depend on the relative stiffnesses of the springs.

To help the "hands-off" students wrap their heads around the conundrum, we guided them through a thought experiment. It is clear that string 1 is not necessary for equilibrium when string 2 is in place, and vice versa. Therefore, we asked what happens when we replace one of these strings by a wet spaghetti noodle. Clearly the noodle cannot support more than a minute fraction of the 10-lb weight. The answer to the problem depends on properties of the "strings". It is information not included in standard statics analyses.

3.1.8 Two-force bodies. In another activity, we ask students to find the support force at pin A for the system shown in Figure 10a. The activity occurred a little more than a week before we began talking about trusses and frames in earnest. To solve the problem, we told students to begin by drawing a free body diagram of the part AC. After drawing a FBD similar to that shown in Figure 10b, students become stumped. There are four unknowns in the pin forces at A and B. Yet, there are only three independent equations one can derive. It looks like a statically indeterminate system. Nonetheless, students are asked to take a closer look at part DB.

Those in the "hands-on" group get long slender rods like those shown in Figure 10c. Students are able to grasp the rod at two pin joints. By handling and manipulating the rods, they *discover*

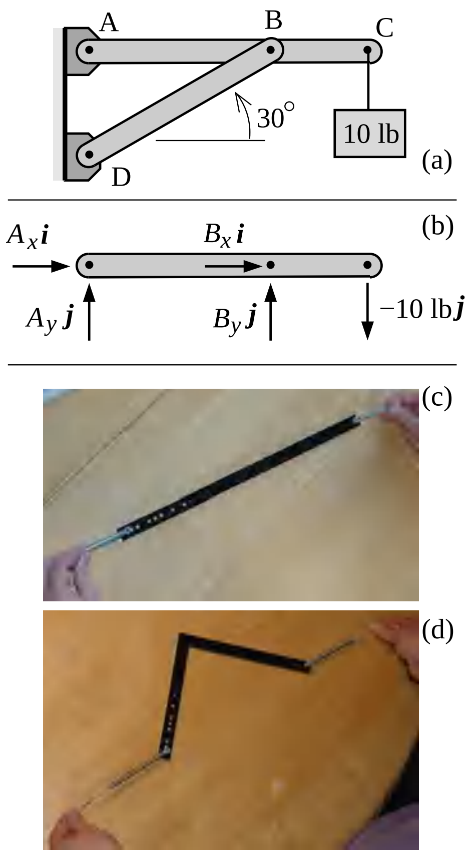

Figure 10: A problem illustrating the characteristics of a two-force body.

that forces in the two-force body must be collinear.

Students in the hands-off group are guided toward this result in the traditional axiomatic way: by drawing a free body diagram and setting up equilibrium conditions.

Armed with is the collinearity result students in both groups are able to eliminate one of the unknowns in the problem and solve for the reaction forces. Finally, we discuss on-shaped two-force bodies like that shown in Figure 10d.

4 Results

To test the effectiveness of the teaching approaches, we collected five measures of student learning. The first two occurred near the half-way point in the semester when we administered two midterm exams. The first exam was a multiple choice concept test that students took on a Friday. Immediately after the exam, solutions were posted online so that students could receive feedback on which concepts were not clear.

The following Monday, students took a problem solving test consisting of two traditional mechanics exercises, similar to the homework problems. On the problem solving test, students were asked to demonstrate that that they are able to complete the entire problem solving process from drawing correct free body diagrams; resolving forces into appropriate components; constructing equilibrium equations; solving the equations; and making a correct interpretation of the result. To grade the problems, we used a rubric that assigns points to each step of the process. It is the same rubric used to grade homework problems. Therefore, going into the exam, students knew exactly what was expected of them.

We conducted the final exam similarly. Students took a multiple choice concept test during the second to last lecture period of the semester. Solutions were posted immediately afterward. Then, five days later, students took a problem-solving test to complete the course.

The fifth assessment of learning was the Statics Concept Inventory developed by Steif [17]. It was administered online over the Internet during the week preceding final concept test. Students were not required to take the Statics Concept Inventory, and their score was not included in their final grade. To motivate students to take the inventory and to take it seriously, we told students that it would be good practice for their final concept test.

According to Steif [16], the correlations between students' exam scores and scores on several categories of the concept inventory are among the highest of all schools participating in the concept inventory.

4.1 Exam Scores

In Figure 11, we report the overall results of the five measures of learning. We are particularly interested in the differences between the "hands-on" and "hands-off" groups. Therefore, in the figure, we present a normalized difference between the average scores:

$$\frac{\bar{X}_{\text{on}} - \bar{X}_{\text{off}}}{S}. \tag{1}$$

Here, $\bar{X}_{\text{on}}$ and $\bar{X}_{\text{off}}$ are the sample averages of scores from "hands-on" and "hands-off" groups. Also, S is the standard deviation of the relevant sample. The error bars represent the 95% confidence intervals for each of the measures, as defined by the corresponding t-distributions. The error bars are symmetric, so each truncated tail represents 2.5% probability.

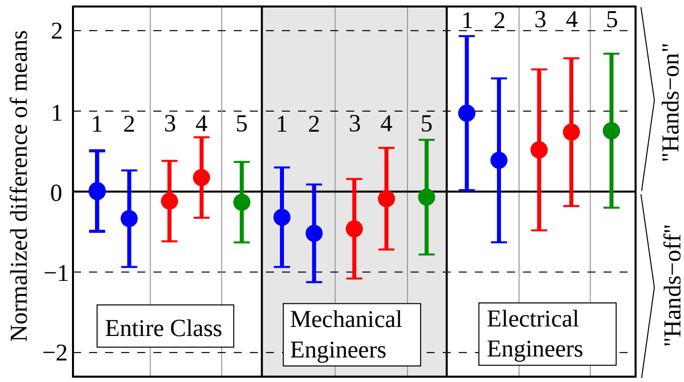

Figure 11: Five measures of student learning for the entire class, just the mechanical engineering students, and just the electrical engineering students. Scores are given by Equation (1). The learning measures are: (1) midterm concept test, (2) midterm problem-solving test, (3) final concept test, (4) final problem solving test, (5) the Statics Concept Inventory.

4.1.1 Consideration of the class as a whole. Figure 11 shows that when one looks at the class as a whole, there is little if any discernible difference between the hands-on and hands-off groups. Upon performing standard two-tailed t-tests for difference of means, we obtain $p = 0.942$, 0.176, 0.616, 0.503, and 0.469 for the five measures respectively. At first glance, it is difficult to say that that either group performed better as a consequence of their particular learning experiences.

4.1.2 Consideration of mechanical and electrical engineering students separately. The picture becomes potentially more interesting, however, when we consider mechanical engineering students and electrical engineering students separately. On average, mechanical engineering students in the "hands-off" group performed better than than their counterparts in the "hands-on" group in all five measures. However, we cannot assert with 95% confidence that the difference is statistically significant since the two-tailed t-tests yield $p = 0.307$, 0.086, 0.136, 0.777, 0.845.

When we consider the performance of electrical engineering students, we do see a statistically significant difference in the midterm concept test. On average, electrical engineering students in the "hands-on" group performed almost one standard deviation better on the midterm concept test than their counterparts in the "hands-off" group. The two-tailed t-test on this statistic yields $p = 0.037$, indicating statistical significance. Electrical engineering students in the "hands-on" group performed better on all four other learning measures as well. The average differences were as large or larger than all other average differences observed. However, the error bars for the electrical engineering students were particularly large due to the relatively few electrical engineering students in the course. There were 18 electrical engineering students (8 hands-on, 10 hands-off) compared to 65 students (31 hands-on, 34 hands-off) overall. Had the sample size been larger, the differences in the other measures may have been statistically significant as well.

4.2 Test Details

Since splitting the class into two groups only persisted for the first half of the semester, the most likely place to see the different effects of the teaching strategies is in the midterm exams. This is corroborated, at least in part, by the summary data in Figure 11. In Figure 12, we present more details of the two midterm exams. Data in Figure 12 come in pairs, showing how mechanical and electrical engineering students separately performed in each of the categories. As before, the data indicate a difference in average performance between the "hands-on" and "hands-off" groups,

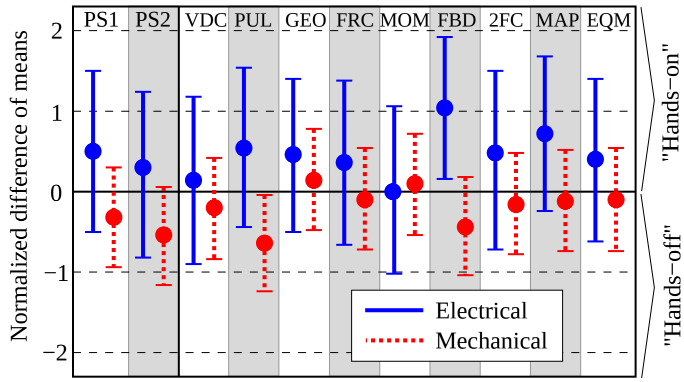

Figure 12: Categorical details of the midterm problem-solving and concept tests. Two sets of data are shown: one for electrical engineering students (solid error bars) and the other for mechanical engineering students (dashed error bars) in the course. Scores are normalize according to Equation (1). Specific categories are outlined in the text.

normalized by the standard deviation (Equation 1).

The first two pairs labeled “PS1” and “PS2” indicate difference in performance on the two questions on the problem-solving exam. The first problem (PS1) is one somewhat similar to the scale problem discussed in Section 3.1.2. By choosing to decompose the forces acting on an object into directions tangent and perpendicular to a cable, the equations of static equilibrium become especially easy to solve. Otherwise it takes a bit more work. Problem (PS2) is one for which students need to determine the conditions under which an object is on the verge of tipping, similar to the crane discussed in Section 3.1.4.

The remaining nine pairs of data are categories in the midterm concept test.

- Category VDC. This is a series of straightforward *vector decomposition* problems in which students were asked to express vectors into mutually perpendicular but nontrivial basis vectors.
- Category PUL. This is a set of *pulley* problems in which students had to recognize that tension on the two sides of a cord laced through a frictionless pulley are equal.
- Category GEO. Problems within this category test whether students can recognize, based on the *geometry* of the problem, whether some forces are bigger than other forces. The scale in Section 3.1.2 is an example of such a problem.
- Category FRC. This is a sequence of problems that test students’ understanding and misconceptions about the standard Coulomb model of static *friction*.
- Category MOM. This is a set of straightforward but nontrivial problems similar to those described in Section 3.1.3, which assess students ability to calculate and evaluate relative magnitudes of moments.
- Category FBD. This is a series of problems that test whether students are able to select correct *free body diagrams* of systems with pins, slots, rollers, and systems with negligible friction.
- Category 2FC. Problems that test whether students are able to recognize when bodies are *two-force bodies* and select a free body diagram that properly reflects the configuration.

- Category MAP. This is a set of *moment application* problems. To receive points in this category, students must recognize the relative magnitudes of moments and determine whether, as a consequence, certain forces are larger than other forces.

- Category EQM. A set of squares are shown with forces acting on them. Students are asked whether it is possible for the squares to be in equilibrium.

As before, the data in Figure 12 expresses the difference between average scores in each of the categories, normalized by standard deviation as expressed in Equation (1).

Many of the problems in the midterm concept test do not fit uniquely into the categories listed in Figure 12. The two-force problems (2FC) problems, for example, fit naturally as a subset free body diagram (FBD) problems. Therefore, for some problems, a correct answer would yield credit in two categories presented in Figure 12. (In calculating students' grades, they did not get multiple credit.) Because we have problems that span multiple categories, interpretation is not as clean as one would prefer in a research project.

4.2.1 Electrical engineering (EE) students. In the free body diagram (FBD) category, we see that EE students in the "hands-on" group score significantly higher ($p = 0.022$, two-tailed) than their counterparts in the "hands-off" group in the FBD (free body diagram) category. As discussed in Section 2.1, this is one of the most important concepts for students to learn.

Because there are relatively few EE students, error bars on the electrical engineering score difference are quite large. The difference between the "hands-on" and "hands-off" EE students needs to be on the order of one standard deviation in order reject the null hypothesis that means are the same (95% confidence, two-tailed). In the FBD category, the difference between the averages is 1.04 standard deviations.

None of the other categorical differences reach that large threshold. Nonetheless, electrical engineering students in the "hands-on" group consistently scored higher than those in the "hands-off" group in all other eight categories. Recall from Figure 11, that the composite concept test scores for EE students were statistically significant. Figure 12 suggests, and deeper investigation of the raw data bears out that the statistically significant difference in the composite score is due the accumulation of differences over all categories.

4.2.2 Mechanical engineering (ME) students. Although less dramatic, the story for mechanical engineering students is almost exactly the opposite. Our ME students in the "hands-on" group scored *lower* than students in the "hands-off" group in almost all categories. The category of pulley problems (PUL) is the only one that reached the threshold of statistical significance ($p = 0.039$). Interestingly, the categories (PUL, FBD, 2FC, MAP) for which our difference measure is most negative for mechanical engineering students are the same categories for which the measure is most positive for electrical engineering students. A similar reflection property exists for the midterm problem-solving exam problems as well.

5 Recap & Discussion

The statement seems obvious: students will learn mechanics concepts better when they have the opportunity to simultaneously *see* and *feel* the phenomena through direct hands-on experiments. The study described herein, however, suggest that the statement is not necessarily true. On the whole, we found essentially no difference between students who were given hands-on manipulatives and those who were not. Both groups of students received instruction that was largely inquiry-based and inductive.

Upon closer inspection of the data however, there appears to be more subtle differences in how mechanical engineering students and electrical engineering students responds to the two teaching approaches. Specifically, we found that EE students in the "hands-on" group performed better on a midterm concept test than their counterparts in the "hands-off" group. The difference is statistically significant in our experiment.

Mechanical engineering students appeared, in some sense, to respond in the opposite way. Those who were given the hands-on manipulatives, on average, performed worse. In fact, they performed worse on all measured categories in the two midterm exams. Nonetheless, the differences were not large enough for us to definitively rule out the possibility that the result might be due to random chance.

We find the different responses among the EE and ME students rather curious and unexpected. It is a result that might lead one to suspect that there are other factors in play. Rather than occupy considerable space describing details of non illuminating data, we simply mention that we did not find any significant differences among the groups and subgroups in their learning styles as measured by Felder & Silverman's [5] *Index of Learning Styles*. Furthermore, there was no significant difference in students' mechanical reasoning ability at the beginning of the semester as measured by the *Differential Aptitude Test for Personal Career Assessment*. The mechanical reasoning test measures the ability to "understand basic mechanical principles of machinery tools and motion." "Items represent simple principles that involve reasoning rather than specialized knowledge or training."[2] The test is designed for people with no more than a high school degree.

Therefore, the differing response of ME and EE students to "hands-on" and "hands-off" instruction that we observed here remains a mystery. Anecdotally, both the primary instructor and the teaching assistant observed that students in the "hands-on" group might have been having too much fun. "Playing" with the Legos$^{\mathrm{TM}}$may have been a distraction from the learning objectives of the hands-on activities. Since electrical engineering students, almost by definition, are not as inclined to be as interested in mechanical gadgets, perhaps they were better able to focus on the learning tasks and benefit from them. Nonetheless, we do not have data to support or refute this speculative conjecture.

Before concluding, we should emphasize that the degree to which one can generalize our findings to other examples of "hands-on" versus "hands-off" instruction is unclear. Certainly, the hands-on exercises could have been designed better. If we had been aware of Dollár and Steif's work on creating hands-on modules for statics [4], including the way in which they re-organized the class, at the time we began the project, we likely would have designed our hands-on activities differently.

Given this, we hope the present work provokes broader and deeper study into impacts that hands-on manipulatives can have on learning, and how the impacts vary in different parts of the student population.

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Effect of order of administration of Performance Assessment and Traditional Assessment

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Abstract

Traditional assessments including examinations are most common or traditional form of assessment. At times these are replaced or supplemented by performance tests not only as an alternative means of assessment, but also for improvement of student learning and performance. This paper presents a study designed to examine three questions. The first question was whether a performance test administered in conjunction with a traditional cognitive test result in increased learning beyond the traditional test alone as indicated by scores on the traditional cognitive test. The second question was whether the order of administration of a performance test and a traditional test result in differential learning as indicated by the combination of performance test and traditional test scores. The third question was whether the order of administration of performance test and traditional test affect knowledge retention as indicated by a final exam. Statistical analysis of the results is presented.

Keywords: Traditional tests, performance tests, order of administration, Effectiveness of tests, knowledge retention

Introduction

Northern Illinois University is the second largest public university in the state of Illinois. It is a comprehensive university emphasizing both teaching and research. The college is committed to build a regional and national reputation as evidenced by its establishment of a program of Scholarship and Teaching Initiative (Vohra, 2005) which has sponsored this study. The college formed a learning community (Lewis and Allen, 2005) with faculty from all four departments of the college. Scarborough (2007) conducted a semester long Faculty Development Program to guide these faculty related to the initiative including development of Self Assessment Baseline, Course Analysis, Student Centered Course Syllabus, Multifaceted Assessment System, Traditional Objective Tests, Performance Assessment & Rubrics etc. Gilmer (2007a) provided the guidance related to development of tests and assessments and their statistical analysis. One of the operational objectives of this program is studying the effect of selected teaching strategies on student learning which will also result in strengthening teaching and student learning. This initiative is also

complimentary to philosophy about synergy of teaching and research advocated by Boyer (1990), Braxton (1996), and Glassick et al (1997).

Among various models of assessment (Marzano et al, 1993), Scarborough (2004) advocated the model of performance assessment for learning (Scarborough, 2004). In this model performance assessment played a key role. National Society for the Study of Education also mentioned that performance assessments are not arbitrarily separated from learning and are less artificial (Wolf & Reardon, 1996). National Education Goals Panel has noted that performance assessments may be more closely aligned with educational goals than traditional tests.

Performance assessments for the proposed study were developed according to the suggestions by the National Education Goals Panel so that they have following characteristics:

1. Be open–ended. Require the students to construct a response or perform an activity.
2. Involve higher-order complex skills. These would include formulating and solving problems, reasoning and communication.
3. Require extended periods of time for performance. Include the collection and analysis of data as well as preparation of written or oral presentations of results and conclusions.
4. Involve group performance.
5. Provide some latitude in the choice of tasks.
6. Provide scoring guidelines or rubrics

Performance assessments along with traditional tests or assessments provide the necessary balance (Wiggins, 1998) in the system required for development of students' ability to perform in types of assessments where they have traditionally shown weaker performance. It may be noted that performance assessments can be of different types (Chatterji, 2003). In our proposed study the performance tasks may fall under the categories of written open-ended assessments and product-based assessments. Huba and Freed (2000) presented how performance assessments are part of Learner–Centered paradigm which are more effective than the Teacher-Centered paradigm associated with traditional assessments. Performance assessments have also been thoroughly discussed by Nikto (2004) where he presents both advantages and disadvantages of performance assessments.

It may be noted that while vast literature exists on performance assessments as evidenced by above cited references, no study has been made so far on the effect of order of performance assessment and traditional assessment and the proposed study is undertaken to fill that void.

In our college, all undergraduate Mechanical Engineering students are required to take a course on Mechanical Vibration and it was decided to involve

this course as part of this Scholarship and Teaching Initiative. The course was first analyzed to identify the gaps for ABET standards, Northern Illinois University general education, student learning objectives and associated teaching models, teaching styles, learning styles, Bloom's taxonomy (Bloom, 1956) and Dale's Cone of Learning (Dale, 1969) and then student learning objectives, examinations (mid term and final), performance assessments and associated rubrics were prepared accordingly. While it is anticipated that active learning (Johnson et al., 1991) facilitated by participating in performance tasks assigned in this course (along with appropriate rubrics, Nitko, 2004) will enhance student learning, the order of performance assessments and traditional tests were decided to be explored as the research question.

Course analysis and subsequent changes

During the workshop for this teaching and learning initiative, the course was thoroughly analyzed in terms of ABET standards, NIU general education, student learning objectives, relation of student learning objectives and teaching models, relation of student learning objectives and teaching styles, relation of student learning objectives and learning styles, and relation of student learning objectives to Bloom's taxonomy and Dale's cone of learning. Three performance tests and associated rubrics were prepared. Each test item (for both mid-term and final) was related to the student learning objectives. Detailed course calendar was prepared where topics and associated teaching model, teaching style, learning style and Bloom and Dale's Cone of learning were listed for each class period.

It may be noted that in the previous years even though ABET outcomes were analyzed for the course; they were not thoroughly analyzed in terms of student learning objectives. This course is not a university defined general education course and as such general education content analysis was not relevant for this course.

Various concepts (Constructivism, Metacognition, Scaffolding, Zone of Proximal Development, and Role of Expert performance) that apply to learning were explored in terms of their application to the course. Regarding Constructivism, even though the current course has both direct and discovery methods, it was mostly direct method. Performance tasks brought in more discovery method to create a balance of these two methods. Regarding Scaffolding, initial assignments had more information but later assignments had less information. Regarding Zone of Proximal Development (optimal mismatches with tasks given to students), it may be noted that for performance tasks, students initially worked individually and since they are at various stages: very rigid or stage I of Optimal Environment to adaptable or stage IV of Optimal Environment, they faced different challenges. However, when they worked together to arrive at best solution, they learnt to be adaptable.

Various information processing models (Joyce et al., 2004) for teaching were studied during the workshop and performance tasks involved Scientific Inquiry and

Advance Organizers. Some problems in the examinations also involved inductive thinking. In terms of social models of teaching, performance assessments relate to both Structured Inquiry and Group Investigation. It also involved Positive Interdependence. Earlier the course was taught mostly as direct instruction (DI) and occasional group investigation (during laboratory exercises). However, the revised course not only involved direct instruction (DI), but also Structured Inquiry (SI). More group investigation (GI) took place because in addition to laboratory exercises, performance tasks were assigned where students start to work individually and then collaborate as a group.

Regarding teaching styles, earlier primarily command and practice styles were followed. Now the revised course also included Guided discovery, Reciprocal, and convergent Discovery. Following Kolb (1976), revised course incorporated all the learning styles: Concrete Experience, Reflective Observation, Abstract conceptualization, and Active Experimentation. Analysis of the course in terms of Bloom's taxonomy revealed that earlier the course and associated homeworks and tests mostly involved the thinking levels of Knowledge, Comprehension, and Application. Rarely any assignment required students to analyze, synthesize and create anything. Revised course includes three performance assessments all of which required students to perform at these higher levels of thinking including the highest level of evaluation and creation. Regarding Dale's Cone of learning, earlier the course format involved more passive and intermediate learning and now due to incorporation of performance tests, more active learning took place.

Research Questions and Design

Students in this class in fall 2006 were divided into two groups (experimental group and research group). Students were randomly assigned to these groups. Both the groups were given same instructions, however one of these groups (experimental group) were assigned the performance test#2 (designing a bicycle vibration seat for comfortable ride from vibration point of view) two weeks before the traditional test (mid term) whereas the other group (control group) was assigned the performance test#2 after the traditional test (mid term). Each group had two weeks to work on the performance test. It may be noted that both groups were given the same traditional mid term at the same time. Both groups had same traditional final exam and same performance tests #1 and #3.

The basic design for this study is presented in the table 1 as shown below.

Table 1. Performance Assessment and Traditional Assessment Administered in Different Order

Group 1 (experimental group)	Instruction	Performance Test#2 (assigned Oct 9, due Oct 24)	Traditional Test (Oct 24)	----------→	Final Exam
Group 2 (control group)	Instruction	Traditional Test (Oct 24)	Performance Test#2 (assigned Oct 24, due Nov 7)	----------→	Final Exam

The first question of whether a performance test administered in conjunction with a traditional cognitive test result in increased learning beyond the traditional test alone as indicated by the traditional cognitive test was addressed by comparing the traditional test means between the two groups.

The second question of whether the order of administration of a performance test and a traditional test result in differential learning was addressed by comparing the combined performance test and traditional test scores between the two groups.

The third question of whether the order of administration of performance test and traditional test affect knowledge retention was addressed by comparing scores from the final exam that are based on material also covered on the midterm (the performance test and traditional midterm test) between the two groups.

Results

The 44 students in the class were divided into two treatment groups: group 1 comprised of 22 students who took the midterm performance assessment (performance task #2) followed by the traditional midterm and group 2 comprised 22 students who took the traditional midterm followed by the performance assessment.

The independent variable in this context is group assignment. The dependent variables depend on the specific research questions addressed. Statistical analyses of the results were performed using SPSS [Gilmer, 2007b] for each dependent variable and they are presented in the table 2. The statistical significance levels are based on independent sample t-tests.

Table 2. Statistical Analysis of dependent variables

Variable	Group	N	Mean	SD	Sig. Level (df=42)
1. Traditional Midterm	1. Perf. First 2. Trad. first	22 22	41.0 41.2	8.9 14.2	0.97
2. Combined Traditional Midterm & Performance Assessment	1. Perf. First 2. Trad. first	22 22	66.8 69.1	9.8 14.4	0.53
3. Final Exam - Midterm Content Only	1. Perf. First 2. Trad. first	22 22	25.7 29.0	6.4 7.8	0.13

The analysis from table 2 indicates that the difference between group means for variable 1 – the traditional midterm exam, was not statistically significant beyond the 0.05 level of significance.

Similarly the difference between the group means for variable 2 – the combined traditional midterm exam and the midterm performance assessment, was not statistically significant.

Table 2 also indicates that the difference between the group means for variable 3 – the final exam scores for the midterm content was not statistically significant.

Conclusions and Recommendations

Although, for all three variables, the mean for students taking the traditional mid term first were higher than the mean for students taking the performance test first, none of the mean differences was statistically significant. This lack of statistical significance indicates that a null hypothesis specifying equal effects of treatment groups in this context is still a viable hypothesis and cannot be rejected.

It may be noted that shortly after the semester started, there was one performance assessment which was given to all students at the beginning of the semester and even this performance assessment was not directly related to the midterm, critical thinking ability of all students increased possibly resulting in similar performance of the two groups.

Another possibility is that students worked hard for the first performance assessment and might not have spent enough time for the second performance assessment and in future the first performance assessment may be abandoned keeping only the second (related to mid term) and the third (related to final) performance assessment to make a definitive conclusion.

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Studying Knowledge Retention through Cooperative Learning in an Operations Research Course

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Abstract

Cooperative learning is defined as the instructional use of small groups so that students may maximize their own learning and each other's learning. The benefits of cooperative learning are well known in literature. In this paper, an experiment using cooperative learning is presented, which was conducted in the first foundational Operations Research course for the industrial and systems engineering program during the fall semester of 2006. The variable "knowledge retention" was used as the performance measure in order to study the success of this technique. In general, results are promising. This paper presents the methodology used, the experiments, results, conclusions and future line of research.

Keywords
Operations research, cooperative learning, knowledge retention, engineering education.

1. Introduction
There is a clear and unmistakable need to improve teaching and learning methods in engineering education not only nationwide [1] [10-11] but also statewide – as asserted by Illinois Commitments' Goal 2: "Higher education will join elementary and secondary education to improve teaching and learning at all levels" (A Citizens' Agenda for Illinois Higher Education –The Illinois Commitment: Partnership, Opportunities, and Excellence; IBHE, 1999.) This not only represents a call for action but also re-activates what the scholarship of teaching in engineering education should be [16].

In a recent study that shows 2004 graduates as significantly better prepared than their counterparts from a decade ago, Lattuca *et al*. [9] conclude the weight of evidence indicates that engineering education in the US has changed dramatically after the implementation of the new ABET Engineering Criteria 2000. These results demonstrate that ABET accreditation philosophy based on assessments of student learning and continuous improvement principles was a milestone in the right direction. However, as pointed out by Sullivan [14], "scattered approaches to reforming engineering education have not [*yet*] resulted in a systemic change" and therefore call for action to produce substantial changes in engineering education remains far still active.

An important aspect is the need to prepare engineering students to function in a rapidly changing world. Nationally, less than 55 percent of students who start engineering studies complete them. Kenney and Dossani [7] say this rate might be severely affected during the next years as outsourcing trends maintain or accelerate in response to ongoing pressure to reduce costs due to economic globalization, unless the engineering curriculum adapts to address this new reality. In this new much more globalized context, the prediction is that engineers of the future might likely take one of two directions; either they become global project managers or entrepreneurs. Consequently, Kenney and Dossani [7] argue engineering students will need an educational system that provides them with the tools to succeed. To educate engineers two decades from now, the National Academy of Engineering (NAE) suggests engineering courses should be taught in such a manner that students get engaged and their curiosity arisen. In other words approaches such as active learning and cooperative (or collaborative) learning should be incorporated in classrooms to produce learner-centered, assessment-centered and knowledge-centered learning environments. The research evidence establishes that cooperative learning promotes deep learning and enhances knowledge retention in students. Based on this premise, this article presents a first attempt to infuse the cooperative learning approach into the first course of Operations Research (OR), which is part of the undergraduate core within the Industrial Engineering (IE) curriculum at Northern Illinois University. In the following sections, a brief discussion on

cooperative learning is presented as well as the methodology used, the experiments, results, conclusions and future line of research.

2. Cooperative Learning

Cooperative learning does not simply mean students working in groups; it goes richly beyond and on top of that. Within the cooperative tasks, individuals look for outcomes that are of benefit to themselves and to all other group members. Johnson, Johnson and Smith [5] define cooperative learning as "the instructional use of small groups so that students work together to maximize their own and each other's learning (p.1-14)." The disposition into groups is to provide students with an environment of social interdependence or mutual dependence rather than competition. Under this idea, the way how social interdependence is structured will determine how group members interact which in consequence affects the outcome achievements. Cooperation or positive interdependence results in more interaction as group members encourage and facilitate each other's learning. On the contrary, a negative interdependence or competition results in oppositional interaction as group members obstruct each other's learning. The absence of interdependence results in no interaction since group members are going to be more focused on individual efforts [12]. Extensive research has been done in cooperative learning – at least 600 studies since 1897 [12]; most of these studies show that cooperative learning favors higher individual achievement than both competitive and individualistic approaches [13]. Just as an example, Hake [4] shows that interaction between students during class time is related with a greater percentage gain on the Force Concept Inventory (measure of students' conceptual understanding of mechanics) when compared with traditional lecture courses. Johnson *et al*. [5] discuss three possible implementations for cooperative learning: informal cooperative learning, formal cooperative learning, and cooperative base groups.

Informal cooperative learning consists of having students work together to achieve specific learning goals through temporary groups that last from a few minutes to one session period [5]. Formal cooperative learning is subject to the presence of the following five elements: (1) *positive interdependence*, team members must be linked to one another in such a way that they maximize their own productivity and that of all other group members; (2) *individual accountability*, all students in a group are held personally responsible to achieve group goals by doing their share of the work and easing the work and effort of other group members; (3) *promotive (Face–to–Face) interaction*, team members must encourage and facilitate each other's efforts to complete tasks and challenge one another's conclusions and reasoning in order to reach group goals; (4) *social skills*, students must be taught and motivated to develop and practice interpersonal and small group skills; and (5) *group processing*, team members must reflect on group member actions and assess them to decide upon direction [5]. Cooperative base groups are long-term, heterogeneous cooperative learning groups with stable membership where students' primary responsibility is to provide one another with encouragement, to be accountable, and to ensure all members are academically progressing [5].

Felder and Brent [3] affirm that a growing body of research continues to confirm the effectiveness of using cooperative learning in higher education. Among the characteristics that cooperatively taught students exhibit when compared to students traditionally taught are the following: higher academic achievement, greater persistence through graduation, better high-level reasoning and critical thinking skills, deeper understanding of learned material, lower levels of anxiety and stress, more positive and supportive relationships with peers, more positive attitudes toward subject areas, and higher self-esteem [15]. Cooperative learning is not only claimed to produce deep learning, which in turn helps students to apply knowledge in other contexts, but also is claimed to promote a positive attitude toward the subject matter and thus increase knowledge retention [2] [6]. When students are successful their self esteem enhances and they tend to view the subject matter with a very positive attitude that creates a reinforcement cycle of good performance, helping to improve both the individual's and group's self esteem [8].

The research evidence establishes that cooperative learning promotes deep learning and enhances knowledge retention in students. Based on this premise, this article presents a first attempt to infuse the cooperative learning approach into the first course of Operations Research (OR), which is part of the undergraduate core within the Industrial and Systems Engineering (ISYE) curriculum at Northern Illinois University. This study is intended to answer the two following research questions:

a) *Does individual learning vs. cooperative learning result in differential knowledge gains as indicated by a traditional cognitive test?*
b) *Does individual learning vs. cooperative learning result in differential knowledge retention as indicated by a final exam?*

With respect to this research matter, cooperative learning has been a recurrent topic within the contents of the Informs Annual Teaching of Management Science Workshop during the last three years. However, no research study addressing the effects of cooperative learning on OR knowledge retention has been found in literature to date.

3. Methodology

In order to examine the impact of cooperative learning versus individual learning on knowledge gain in the form of the two research questions stated above, a sample consisting of 18 students enrolled in the section of the "ISYE 370 Operations Research: Deterministic Models" course, which is part of the core of the ISYE program. In this course, students are first exposed to fundamental methods and applications of deterministic operations research models. The course was separated in two overall groups and students randomly assigned to one of them. Additionally, working teams were formed within each overall group. Literature recommends that each team in cooperative learning should be comprised by two or three members [5]. In this experiment, the working teams were formed out of two and three students.

The experimental design will consist of two treatments: (a) individual learning and (b) cooperative learning, as presented in Table 1. After these two treatments are performed there were two posttests to collect data with which the research questions were answered.

Table 1: Individual Learning vs. Cooperative Learning

Course	Treatment	Posttest 1		Posttest 2
Group 1	Individual Learning	Traditional Test	⟶	Final
Group 2	Cooperative Learning	Traditional Test	⟶	Final

The actual delivery of the treatment conditions alternated across content areas and groups, as shown in Table 2. For this delivery model to work there needs to be an even number of content areas with a minimum of two. Therefore, the following four content areas were considered:

I. Formulation/Graphical Method
II. Formulation of Larger Problem
III. Simplex Method
IV. Duality Theory

Table 2: Order for Treatments

Group	Treatments			
	Content Area I	Content Area II	Content Area III	Content Area IV
1	Individual	Cooperative	Individual	Cooperative
2	Cooperative	Individual	Cooperative	Individual

Group 1 was the individual learning group for content areas I & III while Group 2 was the individual learning group for content areas II & IV. This adds to the validity of the design and enhances the fairness of the treatment conditions within the student groups. Activities assigned during each content area were worked separately by both groups and thus two rooms were needed for this purpose. For the content areas where Groups 1 and 2 became a cooperative learning group, the group was split into working teams for the effectiveness of the approach.

For fairness to students, each content area was weighted approximately equally within both posttests. After the administration of the Traditional Test (Posttest 1) the distinction between the groups was dissolved with instruction

and assessment activities delivered to all students equally. Question 1 was addressed by comparing the Posttest 1 means under the individual and cooperative learning conditions. Question 2 was addressed with similar comparisons on the Posttest 2 means.

Each content area was lectured first and then the class was divided into cooperative and individual groups. Both groups worked on the same in-class assignment during 40 minutes according to certain instructions. The cooperative learning group was required to follow the instructions and time as shown in Figure 1. Whereas the individual learning group was basically required to solve the problem in 30 minutes and then students were exposed to the solution in 10 minutes.

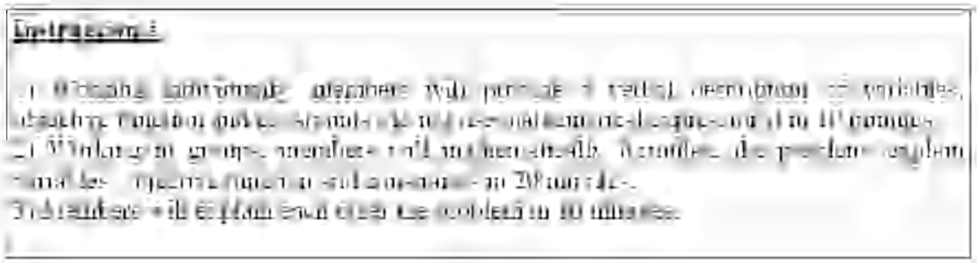

Figure 1: Instructions for cooperative learning group

4. Results

In total eight teams were formed and kept in the class throughout the semester; six teams made up of two members and other two teams of three members. As explained in the methodology section, after the experiment both groups took the midterm exam. This exam consisted of 25 multiple-choice questions to make more objective the evaluation of the diverse contents. Twelve selected questions from the midterm were again given to the students as part of the comprehensive final exam, but the format and the wording were changed. Table 3 shows the results of this experiment.

Table 3: Experiment results

		Midterm			Final		
	N	Mean	StDev	SE Mean	Mean	StDev	SE Mean
Individual	18	29.111	7.977	1.880	3.444	1.381	0.325
Cooperative	18	25.778	9.124	2.150	3.333	1.680	0.396
Difference	18	3.333	7.669	1.807	0.111	1.231	0.290
95% CI mean difference	(-0.48069, 7.14736)				(-0.501248, 0.723471)		
P-value	0.083				0.707		

Since students within each overall group alternate between individual and cooperative learning styles for different contents as shown in Table 2, each student is tested actually based upon both styles. Therefore, a paired-t test was performed to compare the difference between individual learning versus cooperative learning. Table 3 shows the results of the 25 and 12 multiple-choice questions for the Midterm and Final examinations respectively. For instance, the values of 29.111 and 25.778 for Midterm indicate the average scores students obtained in questions for those contents where they worked under individual and cooperative learning styles respectively. In addition, Table 3 shows that the 95% confidence interval for the mean difference between both types of learning used does include zero, which suggests there is no statistical evidence to reject the null hypothesis. The large p-values in both cases (0.083 and 0.707, respectively) further suggest that the data are consistent with H_0: $\mu_d = 0$, that is, both groups perform equally. This result implies that for the experiment conducted both learning styles produced neither differential knowledge gains nor differential knowledge retention with respect to each other, as response to the questions stated in Section 2.

5. Conclusions and Recommendations

Results are clearly not the ones expected according to literature and thus they should be interpreted carefully and in light of this experiment only. In practice, it was particularly difficult to isolate within one single course the real effect of using cooperative learning from individual learning, due mainly to the fact that the students cannot be treated unfairly. Secondly, a content size reduced makes difficult to treat the content properly, which could have happened in this experiment, but again a larger content size may have a negative impact on the fairness. Third, the sample size becomes an important issue in this type of study. Finally, the size of the teams also had an effect in the results. Three-member teams easily got along and worked in general better than some of the two-member teams, in which took longer to unfreeze members before starting to work steadily.

However, the majority of the students reported to feel highly pleased to work and learn cooperatively in teams on their respective topics. It is interesting to note that the content related to OR modeling was reported to be “hard” and “intimidating” by those who worked on this topic individually. All students coincided on that “cooperative learning should be kept” as a teaching method of all OR contents for future courses. This is important because one advantage of working cooperatively in student teams − as instructor − is that teams were easier to supervise and interact with. Instructors can observe students working on assignments together and individually within their teams, but when students work alone it is hard for the instructor to observe the performance of all of them. In addition, it was noticed that student participation in the topics increased, most of them looked more comfortable with providing opinions, comments, and suggestions within their teams for solving problems related to their topics.

The meta-cognitive technique of repeating what students are doing with each other was reported to be effective for their learning. Some of the students said they felt like their ideas were reinforced in them while repeating and explaining a solution to their partners, this is because through this mechanism students were forced to reflect what they are learning.

In conclusion, although results in this experiment do not support the evidence from experiences from other areas reported in the literature with respect to retention gains, neither are they unpromising. The infusion of this cooperative learning type in the Operations Research course has clearly showed an increased level of motivation and participation in the OR contents. Therefore, a recommendation would be to continue the infusion of cooperative learning in OR topics. In the future, teams should be formed not randomly as they were in this experiment, but by also considering students’ learning styles. In addition, the incorporation of the learning cycle (Why? What? How? What if?) should also be stressed in the different activities of teams.

Acknowledgement

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Instructional Research Project

Learning at the Expert Level
"Investigation of the Impact of Cooperative Based Learning on Engineering Student Learning"

Ibrahim Abdel-Motaleb

The ultimate goal of this project is to investigate the techniques and methodologies by which Engineering students can learn engineering subjects at the expert level. What is meant by "expert level" is that the students learn the subject scientific bases, applications, and limitations that allow them to reach the highest level of Bloom's taxonomy: synthesis and evaluation. Reaching such level will in turn allow them to deal with any problem as experts.

To achieve the above goal, several learning methodologies are investigated. In this project, the impact of cooperative learning on engineering students is investigated. The course chosen for this investigation is the three credit hours course, ELE 335: Theory of semiconductors devices I. The course covers the properties of semiconductor materials and the theory of operation of semiconductor devices, including p-n junctions, bipolar transistors, and field effect transistors. To conduct the investigation, a custom model is developed to ensure the integrity and reliability of the results.

Custom Model: The model used in this study is to investigate the effectiveness of Individual Performance-Based Learning vs. Cooperative Performance-Based Learning. The basic research question in this model is: Does individual performance-based learning or cooperative performance-based learning result in better student learning as reflected in an end-of-unit exam (either midterm or final)? The plan for the implementation of the research model is shown in Table I.

Table I. Research Model

Individual vs. Cooperative Performance-Based Learning						
		Treatment	Posttest		Treatment	Posttest
Experimental Group 1	Instruction	Individual Performance-Based	Midterm	Instruction	Cooperative Performance-Based	Final
Experimental Group 2	Instruction	Cooperative Performance-Based	Midterm	Instruction	Individual Performance-Based	Final
	Replication 1			Replication 2		

Procedure:

Students will be randomly assigned to the two experimental groups and therefore those groups can be considered equivalent. The experiment will actually be administered twice during the

semester. To enhance the fairness to the class both groups will be exposed to both treatment conditions – alternating across the two replications. The final is not a comprehensive final so there should be no carryover from the midterm to the final that might contaminate the interpretation of the results.

The research question will be addressed by comparing the mean test scores between the two groups for each replication of the experiment. Two performance tasks will be used. Each performance task is a design project. The design problems are related to the subject matter of the course, but are not directly taught or discussed during the lectures. By choosing such topics, the project topics are not beyond their level, but at the same time they require more research to be fully comprehended and finished. The two performance tasks are assigned as follows:

(A) Pre-midterm Performance Task:
Group-1: This group will be formed in subgroups of 3-4 students, and they will be required to present a group project.
Group-2: This group will be asked not to collaborate with any body while doing their project. Each student will be asked to submit individual project.

(B) Post-midterm Performance Task:
Group-1: This group will be asked not to collaborate with any body while doing their project. Each student will be asked to submit individual project.
Group-2: This group will be formed in subgroups of 3-4 students, and they will be required to present a group project.

In this study, we seek to answer the following question:
1- Which group performed better in the midterm and the final?
2- Can the improvement of performance be related to cooperative learning?
3- Can we relate the students' performance to the timing of the cooperative learning? Is it better to have co-operative learning at the beginning or at the end?

(A) Pre-midterm Performance Task Project

Students are required to design a solid-state device that is not covered in the class, but is based on the material covered in the class. The device chosen is the design of a laser diode that can emit laser at 600 nm wavelength. In this course, ELE 335, Theory of Semiconductor I, lasers are not covered, but semiconductor materials and p-n junction diodes are covered. Since laser diodes are a form of semiconductor diodes, the topic was at the level of the students, but students needed extra research work to complete the design. The extra work is expected to allow them to reach the highest level of Bloom's taxonomy con: of synthesis and evaluation.

In the pre-midterm project, students are required to design the material structure for the laser diode. In this case they have to choose the material composition with an energy gap that produces a wave length of 600 nm. The students realized that there is more than one material composition that can produce the required wavelength. The students realize that it is not enough to have a material that produces the required wavelength, but the lasing should with the highest efficiency. If the material structure they had chosen did not result in high efficiency, they should figure out how to modify the structure to enhance

the efficiency. Because these issues were not covered in the course, they can only understand them from their literatures' search. The details of the pre-midterm performance task project are shown in Table II below.

Table II: Details of the Pre-Midterm Performance Task Project

Pre-Midterm project topic: Design the Material structure for a 600 nm Laser Diode
ABET Criteria: A,C,E,J, and H
Student learning objectives

1. To give students in electrical engineering an introduction to semiconductor material properties
2. To learn the basic theories of modern electronic devices
3. To apply semiconductor theories to design electronic devices and investigate their performance

Task for groups

You are a member of a team of Engineers who are charged to design a laser diode to operate at the wave length specified above. This diode will be manufactured by your company. In this project you need to (a) search the different material structures of laser diodes and (b) determine the best material structure and composition that can be used to build this diode.

You are required to do the following:

(1) search the literature and the internet to learn (a) how laser diodes are built and (b) what the different types of laser diode structures are available in the literatures,
(2) select the material structure that you think is the best to design the laser diode that can meet the design specifications provided,
(3) adjust the material composition and choose the substrate type to ensure that (a) the different materials are lattice matching and (b) the active layer will have the required band gap properties for operation at the above wave length,
(4) validate your choice of the design structure analytically,
(5) compare the group members designs
(6) choose a design for the group (you may modify one of the designs or adopt a new one),
(7) justify the choice of the group design, and
(8) present your design, analysis, findings, and conclusion as report by the deadline.

As a team: (a) Assign specific duties to each member of your research team. (b) Keep a log of individuals and team activities and progress of your work. (c) As you work together you will find you must change certain things to make your team work effectively; be aware of those behaviors you had to change and what you did to change them. (d) Document the changes you observed. (e) Show how you did meet the challenges resulting from these changes. (f) Evaluate the performance of the rest of the group members.

Task for Individuals

You are charged to design a laser diode to operate at the wave length specified above. This diode will be manufactured by your company. In this project you need to (a) search the different material structures of laser diodes and (b) determine the best material structure and composition that can be used to build this

diode.[1]

Individually you are required to:

(1) search the literature and the internet to learn (a) how laser diodes are built and (b) what the different types of laser diode structures are available in the literatures,
(2) select the material structure that you will use in the design of the laser diode that can meet the design specifications provided,
(3) adjust the material composition and choose the substrate type to ensure that (a) the different materials are lattice matching and (b) the active layer will have the required band gap properties for operation at the above wave length, and
(4) validate your choices of the design structure analytically,
(5) justify the choice of the group design, and
(6) present your design, analysis, findings, and conclusion as report by the deadline:

Rubric used in the performance Task evaluation:

A rubric was created to evaluate the performance of the students in the pre-midterm projects is shown in Table III. For individual projects, the grading points were divided as follows: literature review 20%, the design of the device 50%, and the report 30%. For group projects, grading points were divided as follows: literature review counted 20%, the design of the device 40% (10% for individual work within the group and 30% for the work of the group as a whole), group work management 10%, and the report 30%.

Table III. Rubric for performance test evaluation

Criteria	Level of Performance			
	85-100%	60-84%	50-59%	0%
Literature review (20% of total)	Major references are refereed publications and books and the references adequately cover (1) How laser diode is built, (2) Types of laser diode structures.	References covers the two components before but mainly using non-refereed sources	Insufficient coverage of one of the components	No literature review is shown
Individual design Project (50% of total)	(1) The right material structure is chosen; (2) Right adjustments to the material composition are done (3) Right substrate is chosen; (4) Validation for the adjustment is presented.	All components are shown, but justification is not strong	No validation is shown	Unacceptable project
Group Design 40% (Individual work 10%, group 30%)	(1) Individual design is evaluated. (2) Individual designs are compared. (3) New or modified design is developed. (4) New or	All components are addressed, but justification is not strong	No justification is presented	Unacceptable group project

	modified design is justified.			
Group work management (10% of total)	(1) Showing detailed assignments of the group members; (2) keeping a log of the team activities; (3) behavior changes observed; (4) documentation of the behavior changes.	One component is missing	Two component is missing	More than one component is missing
Report writing (30% of total)	Report is well written and includes (1) individual designs, (2) group design, and (c) other components: abstract, introduction, design analysis, results, data analysis, conclusions, and references.	Individual design and group design are well written, but there some of (c) is deficient.	Poorly presented design component	Unacceptable group project

Analysis

The average score on the Pre-midterm performance test was as follows. For group-1 (group projects), the average score of the project is 91.33 %, and for group-2 (individual projects) the average score is only 71.7%. This means the average score of the students with group projects is 27.4% higher than the average score of the students with individual projects. This clearly indicates that the learning outcome from group work, or cooperative based learning, is higher than the individual work, or the individual based learning. The question that needs to be answered is whether the learning outcome achieved because of the cooperative learning enhanced the overall learning outcome of the course materials, or it impacted only the students' knowledge about the project.

To answer this question, the grades of the midterm are analyzed. The average midterm score for students involved in group projects was found to be 71.67% compared with 55.3% for students involved in individual projects. This means that students involved in group projects scored on average 29.57% higher points than students involved in individual projects. It should be noticed here that the percentage increase in the average midterm score for group students is higher by almost the same percentage as the average score of the pre-midterm project (29.5% and 27.4%, respectively). This indicates that the learning level enhancement due to the cooperative learning has been transferred to an exact enhancement of the learning level of the wider course subject mater.

(B) Post-midterm Performance Task

In this performance task, students are required to design the laser diode itself, based on the material structure they have chosen in the Pre-midterm performance task project. This is related to the materials covered in the second half of the course. In the second half, solid state devices, namely diodes, Bipolar Junction Transistors (BJTs), and Metal-Oxide-Field Effect Transistors (MOSFETs), are covered. Therefore, the nature of the Post-midterm project is similar to the nature of the materials covered in this period. Since laser diodes are not exactly similar to regular p-n junction diodes covered in the lectures, it is expected that the Post-midterm project will force the students to do more research and hence allowing the students to reach the highest level of Bloom's taxonomy: of synthesis and evaluation. The details of the pre-midterm performance task project is shown in Table IV below, and the rubric for grading is the same as the rubric shown in Table III.

Table IV- Post-Midterm Performance Task

Post-Midterm Project Topic: Design the a 600 nm Laser Diode
ABET Criteria: A,C,E,J, and H
Student learning objectives

4. To give students in electrical engineering an introduction to semiconductor material properties
5. To learn the basic theories of modern electronic devices
6. To apply semiconductor theories to design electronic devices and investigate their performance

This is a continuation of the Pre-Midterm project where the diode will be designed and its performance evaluated at the above wave length. The material structure chosen in the Pre-Midterm project must be used in this design.

Individually, you are required to:

(1) search the literature and the internet to (a) learn how laser diodes are built and (b) understand how the device performance can be evaluated,
(2) use the laser diode material structure you have chosen in the Pre-Midterm project to design your diode,
(3) simulate the diode performance and fine tune the material structures, composition, and doping to ensure the diode has high efficiency, high reliability and manufacturability, and low cost, and
(4) validate, analytically or using software, that your design will best meet all the design requirements mentioned above.

As a team you are required to

(1) evaluate and compare the individual structure design,
(2) either develop a new design or optimize the best individual design, so that the diode will best meet the design specifications mentioned above. structure design that will, most likely, result in operating at the specified wave length, and
(3) justify the choice of the group design.

As a team: (a) Assign specific duties to each member of your research team. (b) Keep a log of team activities and progress of your work. (c) As you work together you will find you must change certain things to make your team work effectively; be aware of those behaviors you had to change and what you did to change them. (d) Document the changes you observed. (e) Show how you met the challenges resulting from these changes.

Present your design, analysis, findings, and conclusion as:

- The report from this activity should be combined with the Pre-midterm report to form one project.
- A group report should contain the activities done by each student.

Analysis
The grading of the post-midterm performance task project shows that the group-1 (individual projects) has an average score of 87.9% while grou-2 (group projects) has a score of 93.6%. The group project

students average score is about 6% higher than the average score of the individual project students. The average score for both groups is statistically the same. The invariance between the scores of the two groups is logical, since at this point all students have already experienced cooperative learning. Group-1 experienced it during the pre-midterm project and group-2 during the post-midterm project. Therefore, their learning curves of all students should be the same, and this what the grades of the post-midterm projects show.

The question that needs to be answered is whether the enhancement of the learning curve shown from the scores of the projects has been transferred to an enhancement of the wider knowledge of the course materials or not. The final examination scores can give a good answer to this question. The results show that group-1 average score is 69.9 % and group-2 an average score is70.4%. This means that they are statistically the same. This again is in agreement with the scores of the projects themselves. This means that group-1 learning curve has been enhanced due the cooperative learning of the pre-midterm project, while group-2 learning curve has been enhanced due to the cooperative learning of the post-midterm project. Since every group has experienced group learning, they should have the same level of knowledge, and this is what the results indicate.

The question that needs an answer now is which is better: to do the cooperative learning project at the beginning of the course or at the middle of the course. The final examination appears to indicate that the timing of the project does not affect the learning curve of the students, since the average score is the same for both groups. Considering the results from both the midterm and the final exams, it appears that group-1 scores are higher than group-2 scores, since group-1 scored high in both the final and the midterm, while group-2 scored higher in the final only. This also means that the average score for all students will be high, as long as they start their cooperative projects at the same time. Starting the group projects in the second half of the semester may be attractive, since it reduces the load on the instructor, while producing the same results.

From the above discussion, one can be sure that the learning curve of group-1 becomes high for all the course materials (pre- and post-midterms), while group-2 learning curve becomes higher only in the post-midterm materials, and it is not clear what is their level in the pre-midterm material. To investigate the impact of the timing on the learning level for all course material, a take-home examination was given to all students at the end of the course. This take home examination contains design problems that require the knowledge of all the course materials. The results show that the average score of the take-home examination for all students is 70.3% which is exactly the same as the average score for the final examination and the post-midterm project for both groups. These results may suggest that the timing of the project is not critical. However, when we calculated the average score for group-1 separately from group-2, it was found that the average score for group-1 is 80% compared with 52.2% fro group-2. This shows that when the students are tested for all course materials, the group that did the project at the beginning faired much better. This means, cooperative learning affects the learning level during and after the doing the group project, but it does not significantly affect the learning level retroactively. In other words, the earlier the cooperative learning starts the higher the learning curve will be.

Conclusions

From this study one can conclude the following:

1- Cooperative learning results in significant improvement in the learning performance of the students.

2- Cooperative learning affects the learning performance during or after the group work, but not retroactively.
3- To ensure the best results for all the students, cooperative learning should start as early in the semester as possible.

The Study of Knowledge Retention and Increased Learning Through the Use of Performance Based Tasks

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Abstract

This study examines the effect of complex performance assessments with multiple embedded tasks on both student performance and retention of knowledge in a senior/graduate level engineering decision theory class. The research looks at whether a performance based task covering a subset of content also covered in a traditional cognitive test results in increased learning and knowledge retention beyond the traditional test alone, as indicated by traditional cognitive tests. This paper presents the methodology, results, conclusions, and future line of research.

Keywords: performance tasks, cognitive tests, knowledge retention, traditional assessment, alternative assessment

1. Introduction

There have been many excellent publications over the past several decades discussing how to improve student learning. Much of the discussions about knowledge, learning, critical thinking, and constructivism directly or indirectly relate to, or include, active learning as a requirement. Bloom's *Taxonomy of Educational Objectives* [5] is the most prominent learning taxonomy in use in education today. Deeper knowledge is hopefully achieved as one moves to the higher levels (e.g. synthesis and evaluation). The higher levels often involve active learning participation. Edgar Dale's Cone of Learning [9] has also been a standard model of reference. Active learning occurs when students talk, listen, read, write, and reflect. Problem based learning (PBL) and training in problem solving techniques are often implemented to engage the students in active learning. Chickering and Gamson wrote the "Seven Principles for Good Practice in Undergraduate Education." Principle number three encourages active learning, and states that "Learning is not a spectator sport… Students must talk about what they are learning, write about it, relate it to past experiences, and apply it to their daily lives." [8]

The emphasis on active learning has occurred due to the fact that many believe it fosters better retention, as well as leads students to expand their thinking abilities. [11] Bransford's research [6] showed that students were more likely to retain information when that information was rehearsed or used to solve problems. Active learning implies that the student is actively participating in the learning process. If this is done, then the higher levels of Bloom, such as synthesis and evaluation, will be achieved. Rebecca Anderson [1] discusses the shift from traditional assessment to alternative assessment. Some of the pertinent beliefs and assumptions of traditional assessment are that it treats learning as a passive process [13], it separates process from product [3], and assessment is objective [2]. Alternative assessment is said to treat learning as an active process [17], emphasize process and product [14], and view assessment as subjective and value-laden [4]. Scarborough [18] suggested a balanced approach to assessment, using a variety of tools or procedures. This, in effect, should help to offset limitations of one type of assessment against the strengths of the other.

The most typical form of assessment during much of the past century in the United States has been the use of traditional assessment, and more specifically, the traditional cognitive test. In this environment the learning cycle most likely entails the student attending lectures and acquiring information from the "expert", as well as from readings. The demonstration of knowledge, or assessment technique, would then be in the form of a traditional cognitive exam. In the mid 1980's the Western world started to consider the desire to foster lifelong learning, and the belief that fair and accurate assessment could be achieved, through "descriptive review," for tasks demonstrating complex products. This move toward performance based tasks also moves the student towards the engagement in active learning.

The literature is rich with discussion about assessment techniques for performance based tasks and the need for students to engage in active learning. Several are referenced here. [7, 10, 12, 15, 16, 19, 20, 21] Even though many fine methods have been offered for assessing performance tasks, many in the fields of engineering and science will no doubt argue that certain key fundamentals must be mastered and tested objectively, with assessments such as the traditional cognitive test. Unfortunately, very little can be found that describes or discusses the effect, if any, of students participating in performance based tasks and the ensuing performance on traditional cognitive tests. The work presented addresses this area of research. This paper will describe a one semester study of a senior/graduate level decision theory class to explore if participation in active learning helps students perform better on traditional assessments, and if retention can be increased. The performance tasks the students worked on in the decision theory class used for this study achieved high levels on Bloom's taxonomy, as well as active learning according to Dale's Cone. They were required to apply, synthesize, and evaluate an open-ended system of their choice by applying the principles of decision theory. Oral presentations as well as written work were required for this project.

2. Methodology

This study examines three questions with regards to student performance on traditional tests and performance tasks. The underlying procedure for all questions will be to divide the students into two randomly chosen groups. One group will be assigned a performance task (Performance Task (PT) #1a) in which decision tree methodology is to be implemented in the solution to the task. The second group will be required to utilize fault tree analysis in their solution of the performance task (Performance Task #1b).

The three questions are outlined below. The corresponding null and alternative hypotheses are stated.

1. Does a performance based task covering a subset of content also covered in a traditional cognitive test result in increased learning beyond the traditional test alone as indicated by the traditional cognitive test?

This question will be studied by using the following procedure.

- Each student was assigned randomly to one of two groups. One of these will be termed the experimental group and the other the control group.
- The treatment for the experimental group was the administration of the traditional test (midterm exam) along with a performance task (PT #1a), which included activities (decision tree analysis) covering some of the same content that was covered in the traditional test (midterm exam).
- The treatment for the control group was the administration of the traditional test (midterm exam) and a placebo for the performance task (PT #1b), which included activities still vital to the class (fault tree analysis) but not covered in the content of the traditional test (midterm exam).
- After the administration of the traditional midterm exam (Posttest 1) the distinction between the groups was dissolved with instruction and assessment activities delivered to all students equally.

Comparing the posttest 1 means for the questions regarding decision trees across both the experimental and control groups will address this question. A t-test for significance was performed and the significance level was determined. A two-tailed test was implemented.

Null Hypothesis - H_O: μ(experimental group: decision tree) = μ (control group)

Alternative Hypothesis – H_A: μ(experimental group: decision tree) $\neq$ μ (control group)

2. Does a performance based task covering a subset of content also covered in a traditional cognitive test result in increased knowledge retention beyond the traditional test alone, as indicated by a final exam?

This question will be studied by using the following procedure.

- The experimental and control groups remained the same as in Question 1.
- The treatment for the experimental group was the administration of the traditional test (final exam) along with a performance task (PT #1a), which included activities (decision tree analysis) covering some of the same content that was covered in the traditional test (final exam).
- The treatment for the control group was the administration of the traditional test (final exam) and a placebo for the performance task (PT #1b) with regards to decision tree content.

After the administration of the traditional final exam (Posttest 2) the distinction between the groups was dissolved with instruction and assessment activities delivered to all students equally.

Comparing the posttest 2 means for the questions regarding decision trees across both the experimental and control groups will address this question. A t-test for significance was performed and the significance level was determined. This was a two-tailed test. Figure 1 below details Questions 1 and 2.

Null Hypothesis - H_O: μ(experimental group: decision tree) = μ (control group)

Alternative Hypothesis – H_A: μ(experimental group: decision tree) ≠ μ (control group)

		Treatment	Posttest 1		Posttest 2
Experimental Group	Instruction	Performance Task #1a – Related to Traditional Test (decision tree content)	Traditional Test (Midterm Exam)	→	Traditional Test (Final Exam)
Control Group	Instruction	Performance Task #1b – <u>Not</u> Related to Traditional Test (fault tree content)	Traditional Test (Midterm Exam)	→	Traditional Test (Final Exam)

Figure 1: Relationship Between Experimental and Control Groups for Questions 1 and 2

3. Does administration of a performance based task affect retention on a traditional cognitive test (final exam) compared to no performance assessment?

This question will be studied by using the following procedure.

- Each student was assigned randomly to one of two groups. One of these will be termed the experimental group and the other the control group. The students will remain in the same groups, the only difference is the designation of the experimental and control groups.
- The treatment for the experimental group was the administration of the traditional test (final exam) along with a performance task (PT #1b), which included activities (fault tree analysis) covering some of the same content that is covered in the traditional test (final exam).
- The treatment for the control group was the administration of the traditional test (final exam) and a placebo for the performance task (PT #1a), which was based on decision tree content. This group did not have a performance task related to fault tree content.
- After the administration of the traditional final exam (Posttest 2) the distinction between the groups was dissolved with instruction and assessment activities delivered to all students equally.

Comparing the posttest 2 means for the questions regarding fault trees across both the experimental and control groups will address this question. A t-test for significance was performed and the significance level was determined. This was a two-tailed test. Figure 2 below details Question 3.

Null Hypothesis - H_O: μ(experimental group: fault tree) = μ (control group)

Alternative Hypothesis – H_A: μ(experimental group: fault tree) ≠ μ (control group)

		Treatment	Posttest 1		Posttest 2
Experimental Group	Instruction	Performance Task #1b – Group having a Performance Task with fault tree content	---------	→	Traditional Test (Final Exam)
Control Group	Instruction	Performance Task #1a – Group <u>not</u> having a Performance Task with fault tree content	---------	→	Traditional Test (Final Exam)

Figure 2: Relationship Between Experimental and Control Groups for Question 3

3. Analysis

3.1 Data for Study Question 1

Does a performance based task covering a subset of content also covered in a traditional cognitive test result in increased learning beyond the traditional test alone as indicated by the traditional cognitive test (midterm exam)?

The midterm exam contained questions covering subject matter related to decision trees, and not to fault tree analysis. The methodology for the calculation of the significance levels is critical. Table 1 illustrates the data for

the midterm exam. The experimental group participated in the decision tree performance task (PT), while the control group participated in a fault tree PT. The total points possible for this section of the test were 28 (with 100 total points possible for the entire exam.)

Table 1: Scores for the Traditional Cognitive Midterm Exam

	Average Score on Decision Tree questions	Variance of Score Decision Tree questions
Experimental Group (Decision Tree PT)	18.28571	1.16224
Control Group (Fault Tree PT)	16.85714	2.12244

Note that the scores for the students who were in the experimental group, those who participated in a performance task covering a subset of content also covered in the traditional cognitive midterm exam, scored higher and had a lower variance. The question is how significant is this difference? The calculation of the variance is the critical issue. In order to obtain this number the following procedure was implemented:

- A sample variance was found for each decision tree test item for the experimental group.
- Subsequently, the value of the variance of the sample average for each question must be calculated. To obtain this value the sample variance was divided by the number of students in the group.
- The overall variance for the experimental group for all questions related to decision tree subject matter can be found by summing all of the variances of the sample averages for the experimental group.
- This was then repeated for the control group.

The significance question was answered by performing a t-test. The calculated t-value for this group of data was 0.739. The two-tail area for this t-value came out to 0.462. Consequently, 53.77 % of the time one would expect the scores for the experimental group to be higher. (Significance = 53.77 %)

3.2 Data for Study Questions 2 and 3

Does a performance based task covering a subset of content also covered in a traditional cognitive test result in increased knowledge retention beyond the traditional test alone, as indicated by a final exam (a traditional test)? For this question the experimental group is the same as in section 3.1.

Does administration of a performance based task affect retention on a traditional cognitive test (final exam) compared to no performance assessment? For this question the experimental group is now the group of students who participated in the fault tree PT, and the control group consists of those participating in the decision tree PT.

The final exam contained questions covering subject matter related to both performance tasks. The analysis was performed in the same way as in section 3.1. Table 2 gives the data for the final exam for both study questions.

Table 2: Scores for the Traditional Cognitive Final Exam

	Average Score on Decision Tree questions	Variance of Score Decision Tree questions	Average Score on Fault Tree questions	Variance of Score Fault Tree questions
Experimental Group Question 2 (Decision Tree PT)	25	1.46938		
Control Group Question 2 (Fault Tree PT)	22.71429	2.79591		
Experimental Group Question 3 (Fault Tree PT)			38.42857	1.39463
Control Group Question 3 (Decision Tree PT)			35.71429	1.82998

The significance level information for both study questions is contained in Table 3.

Table 3: Data Results for Research Questions 2 and 3

	t-value	Significance Level
Study Question 2	1.107	72.73%
Study Question 3	1.512	86.57%

It is evident from Table 3 that whichever performance task the student groups participated in corresponded directly to the overall performance of that group on the traditional test. The performance on final exam test items related to decision tree analysis subject matter was directly correlated to the performance task subject matter. This also held true for performance on final exam test items related to fault tree analysis subject matter.

4. Results and Conclusions

This paper studied (as addressed in research questions 1 and 3) the effect of complex performance assessments with multiple embedded tasks on increased learning beyond a traditional test alone in a senior/graduate level engineering decision theory class as indicated by traditional cognitive tests. This research found that for this particular class a performance assessment task covering a subset of content also covered in a traditional cognitive test resulted in increased learning. This was evidenced by higher scores on the decision tree content midterm test items for the experimental group. This also occurred on the final exam, with the fault tree group scoring higher on the fault tree related items in the traditional final exam. It is important to also observe that the variances in the scores were lower for the experimental groups, meaning that the scores of these students were also more consistent with each other.

This research also looked at the knowledge retention beyond the traditional test alone, as indicated by traditional cognitive test (as addressed in research question 2). This was done by tracking the student scores on the final exam for the group participating in the decision tree PT. The data also points to an increase in the scores for these students on the portion of the final that dealt with decision tree subject matter. The variance for these students was also lower, once again indicating a more consistent performance. Figures 3 and 4 illustrate these points for all three research questions.

This study does indicate that students performing active learning, via a performance task, do in turn translate that into better performance on traditional tests. It must be noted that additional data analysis for this study will be performed to examine the effect of strength of student bias on the results. In other words, what is the effect of an excellent student on the overall results, and what is the effect of a poor student. It should also be investigated as to what level of additional exposure to subject matter content aids in increased learning and retention. Additional work should also concentrate on looking at the variance component. The results achieved in this work definitely warrant further research into this area of student learning.

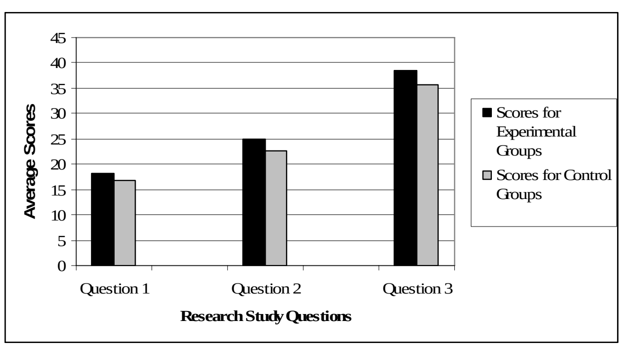

Figure 3: Scores for Experimental Groups Vs. Control Groups for All Three Questions

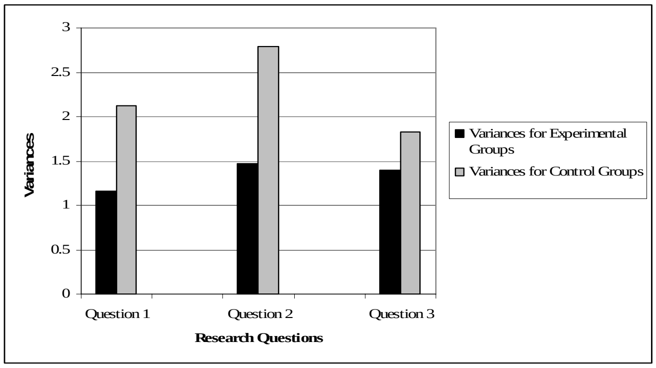

Figure 4: Variances for Experimental Groups Vs. Control Groups for All Three Questions

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Initiative Biographies

The group of professors who participated in The Scholarship of Teaching Initiative were a dedicated faculty group. They joined the Faculty Learning Community with open, professional, and enquiring attitudes. Their humor and ability to critique themselves was outstanding throughout the entire process of critical reflection and development. Each faculty member involved in this pilot initiative reflected his or her serious interest, dedication to teaching and learning, professionalism, camaraderie, and leadership without question. Very important to the program leadership is that they were extremely supportive of the leaders. As one of those, I must say that I have never been treated more professionally or respectfully. And although the Initiative activities were well researched and developed, described, discussed, and agreed to at the beginning of the program, it was impossible to realize at that time what the full extent of the work load would be as it was a pilot program and our first time offering the program. However, each and every faculty participant completed everything asked of them; they were tolerant – allowing aspects of the program to develop as the process and content evolved. As anyone who leads professional development knows, regardless of how well the content is planned, even when based upon an extensive and diversified needs assessment, and how well all the materials are developed, each individual and group collectively is different, and things become known that were not beforehand, or adjustments must be made that were not predictable, or a program component is needed that was unexpected, and more. The most significant outcome of the experience was that there is now a group of eight professors who would like to continue to work together on teaching and learning. Some of us wondered throughout the process why we had not worked together before. That outcome is what we hoped would occur.

Promod Vohra, Ed.D., PE, CSIT- Electrical Engineering. Dean, College of Engineering and Engineering Technology. Well published. Outstanding grant awards and industrial contracts.

Regarding this Initiative, the most important points to make about the Dean of the College are about leadership. He has a vision that fully acknowledges and includes The Scholarship of Teaching as Boyer (1990) intended it to be, integrated, interactive, interdisciplinary, and equal to all other types of research: discovery, integration, and application. Most important is that he believes in "Transforming Leadership" as defined by Burns (1978) and "Superleadership" as defined by Manz and Sims (1989). These theories are all about transforming others into leaders or acknowledging and empowering the leadership capabilities in others; they involve the development of leaders where everyone is raised to higher levels intellectually, morally, and ethically. This initiative is all about leading and empowering others; that is the heart of teaching and learning. We provide learning experiences where our students achieve their highest possible potential in their time with us and go on to achieve more. We develop their intellectual and personal capability to learn, lead, and ultimately to transform their world. Dean Vohra has elevated "teaching" to its rightful status among scholarly activities in the college. He has empowered the program leader, acknowledged her experience and capability to lead a group of engineering and technology faculty, and empowered the faculty members to formally create and engage in a learning community that will sustain scholarship on teaching for the future; they have now become the leaders as they no longer need the initial leader. Dean Vohra has committed to sustaining leadership and support and quietly empowered his faculty in the true sense of "empowerment" where one gives up their own power to empower others to lead.

Faculty Participants

Abul K.M. Azad, Ph.D. – Electrical Engineering. Associate Professor, Electrical Engineering Technology. Interests are logic design, microprocessing, communication systems design, digital communications. Significant Grants awarded by the National Science Foundation, the U.S. Department of Education, and the Engineering and Physical Science Research Council, UK. Grant focii: Robotics, program development, and analysis of railroad barriers for transportation planning. Well funded by NIU for internal grants: web based laboratory development, design and development of crowd control system for public spaces, internet based simulation and control of environment; intelligent modeling; artificial intelligence for robot manipulators; collaborative interdisciplinary simultaneous engineering project development, and more. Published articles include the following topics: Internet-based laboratory experiments in engineering technology; Design and development of a cost effective data acquisition system using PC's parallel port; Internet-based facility for physical laboratory experiments. He co-edited *Flexible Robot Manipulators-Modeling, Simulation and Control.* UK.

Coller, Brian, Ph.D. - Mechanical Engineering. Assistant Professor, Mechanical Engineering. Industrial experience includes Hughes Aircraft Company. Interests are digital control, dynamic systems and control, engineering mathematics. Grants awarded by the National Science Foundation. Grant focii include nonlinear dynamics of triggering controllers, advanced computing in mechanical engineering, automotive engineering, ethanol vehicles, and more. Published articles on Intriguing nonlinear dynamics of a controller with a sluggish actuator; Surge/stall interactions in compressors; Open loop control of planar diffuser flow; A study of double flutter; Structural nonlinearities and the nature of the classic flutter instability; Optimization of an E85 powered Chevrolet Silverado; Vortex model for control of diffuser pressure recovery; Beneficial actuator-induced bifurcations in compressor control; Evolving control strategies for suppressing heteroclinic bursting, and more.

Abhijit Gupta, Ph.D. – Mechanical Engineering. Associate Professor Mechanical Engineering. Significant Grants/industrial contracts awarded on vibration analysis of exhaust systems; modal analysis of V229; vibration analysis of sensor and port; analysis and design of pelican guide wheel suspension; fatigue behavior of foams. Co-lead on acoustics and vibration project. Published articles on: finite elements; development of adaptive algorithm for active sound quality control; active vibration control of a structure by implementing filtered-XLMS algorithm; a direct method for matrix updating with incomplete measured data and without spurious modes; effectiveness of a sprayable damper studied using multiple test methods; electromagnetic shock absorbers; a damage identification method using vibration modal parameters through finite element discretization, and more.

Reinaldo Moraga, Ph.D. – Industrial and Systems Engineering. Assistant Professor Industrial and Systems Engineering. Interests are statistics for engineers, operations research, industrial control systems, systems simulation, simulation modeling and analysis, discrete systems simulation, advanced experimental design for engineers. Grants awarded on application of operations research and management science models in disaster operations management; modeling and simulation of cost considerations throughout design processes; design of heuristics for production scheduling problems; systems models and process optimization; extensions of meta-RaPS to machine

scheduling problems; effective solution approach for solving the 0-1 multidimensional knapsack problem; simulation modeling and analysis of space shuttle flight hardware ground processing; risk analysis methodologies, techniques, and tools for ground operations. New professor; grant proposals in process. Patents: Virtual Reality Interactive Software for Teaching in Robotic and Material Handling Systems; Garden Table. Publications on using system dynamics, neural nets, and Eigenvalues to analyze supply chain behavior; application of SCOR to E-Government; detecting and analyzing patters in supply chain behavior; disaster and prevention management for the space shuttle during lift-off; heuristic approaches for the unrelated parallel machine scheduling problem with machine-dependent setup times, and more. Book Chapters include *Meta-heuristics: A solution Methodology for Optimization Problems* in Handbook of Industrial and Systems Engineering; *Technological Proposal for Computer Aided Education: Two Cases of Virtual Reality Applications* in Gestion de la Docencia e Internacionalization en Universidades Chilenas.

Ibrahim M. Abdel-Motaleb, Ph.D., PE – Electrical Engineering. Professor Electrical Engineering. Interests are electrical circuit design and analysis; semiconductor devices and fabrication; integrated circuits; electrical microsystems. Grants or contracts awarded by industry on rapid optimization of commercial knowledge for U.S. Army-Vehicles Center for Bribology and Coatings; testing and evaluation of S&N relay for use in earth movement vehicle; nanofabrication education; characterization of ZnSe/Ge Hetrointerfacese using BioRads SLTS system and electrochemical C-V profiler; investigation of nitrogen doping on field emission device characteristics; magnesium diffusion in gallium nitride; characterization of magnesium oxide MOS capacitor; zinc eleenide semiconductors; integrated microelectronic systems; also, MEMS sensors; nanotechnology; material growth and characterization; device fabrication and characterization; integrated circuit fabrication; modeling and simulation. Publications on modeling and simulation of bipolar junction transistors using the theories of thermodynamics; characterization of ZnSe/Ge material growth using the Atomic Force Microscope; non-quasi static modeling of HBT junction capacitance; and more.

Regina DeMers Rahn, Ph.D. – Nuclear Engineering. Assistant Professor in Industrial and Systems Engineering. Industrial experience at GeneMetrix. Interests are quality control; manufacturing systems; six sigma performance excellence; modern problem solving; productivity and modeling and improvement; process capability; process modeling; reliability; engineering statistics; decision modeling. Publications on potential distribution in a remote hollow cathode glow discharge deposition source; technical feasibility studies, tag design computer code; weighted median method for centerline estimation; cost/throughput improvement; quality improvement. Director of Carter Program for Women in Engineering; Research/development/industry contracts on high resolution software for performance metrics; new methodology for job shop scheduling, capacity calculations, and cost estimations.

Robert Tatara, Ph.D. – Chemical Engineering. Assistant Professor, Plastics Technology. Interests are chemical qualities of plastics/composites; manufacturing processing and technology; heat transfer; fluid mechanics; engineering thermodynamics; experimental methods in engineering; refrigeration and air conditioning. Research/industrial contracts on manufacturing potential for ethanol processing residue streams; use of corn processing co-product as a biofiller material in a plastic resin; thermoforming; high temperature excursions due to shear heating, during injection molding of ABS plastic melts; special mode inserts to lengthen cooling time of injection molded

plastic parts to reduce residual stresses; quantified effects on resin melt viscosities of filler materials using a capillary rheometer; plastic processing simulation software evaluation. Co-Investigator "Experimental Determination of the effects of Oil on Heat Transfer in Flooded Evaporators." Publications on analytical and experimental studies of properties of ethanol coproduct-filled plastics, modeling injection molding procession of a polypropylene closure having an integral hinge; measurement of forces developed by a double-acting mopneumatic cylinder; measurement of spray boiling refrigerant coefficients in an integral-fin tube bundle segment simulating a full bundle; pool boiling of pure R134a from a single Turbo-BII-HP tube; effects of oil on boiling of replacement refrigerants flowing normal to a tube Bundle-(art II. R-134a and 123); and more.

Jerry Gilmer, Ph.D. – Educational Psychology, Measurement and Statistics. Director of Testing Services, NIU. Program Associate. Developed and taught the student assessment program component on test analysis and development. Collaborated with Jule Scarborough on the program and classroom research design, methodology, and statistical procedures. Developed and produced the research designs and statistical reports on program. Industrial experience as measurement specialist, research scientist assistant, and director of Law Programs Test Development.

Gail Jacky, Director of NIU's Writing Center. Edited the Portfolio with great patience and always a smile.

Jule Dee Scarborough, Ph.D. – Distinguished Professor, Emeritus. Technology-Emeritus, 2007. Researched, conceptualized, developed, directed, and taught most of the faculty development program and research semester for The Scholarship of Teaching. Produced and documented all of the conceptual research; designed and developed all the program process, teaching and learning materials (e.g., instruments, feedback and evaluation forms, program worksheets, presentations, etc.). Designed program and classroom research, methodology, and statistical procedures in collaboration with Jerry Gilmer. Documented and produced the College Portfolio. Distinguished grants and teaching professor. W.K. Kellogg National Leadership Fellow. Studied in 46 countries for extended time. Nationally recognized and awarded for research , teaching, and professional activities. Recognized and awarded by NIU. Grant awards total approximately 10 million from National Science Foundation, State of Illinois; also, additional contracts with business and industry. Active with business and industry as consultant, grant partner, and research on leadership in manufacturing sector. Outstanding Graduate Professor. Teaching areas include Industrial and Engineering Management and Leadership. Program Leader - Project Management Graduate Certificate and Master's Specialization. Twenty-five years teaching graduate courses on Total Quality Management, International Business, Industrial Leadership, Advanced Project Management, High Performance Teaming, and undergraduate senior design capstone; also 16 years teaching engineering/industrial technology: automated manufacturing (e.g., automated systems, PLCs, automated controllers, senior design capstone course). Twenty-three years working with high schools to improve mathematics, science, and technology in secondary education. Well published. Retired 2006.

PROFESSOR KNOWLEDGE ASSESSMENT

(See Research, Portfolio Section A.3)

Jule Dee Scarborough, Ph.D. and Jerry Gilmer, Ph.D.

Assessment of the professor's knowledge on teaching and learning served as one of the research and evaluation variables to determine the success of the CEET faculty development program. Therefore, a pretest was administered before each program component, and a post
-test was administered upon the completion of each program component. With some program components, however, a third assessment was administered, as we were interested in observing retention. Also, note that some of the assessments were performance based. For example, once the professors were tested traditionally on test analysis, they were also required to perform two test analyses during the research semester on the new midterm and final exams. All seven professors performed the midterm analysis; six of seven performed the analysis of the final exam; they all prepared a diagnostic write up. The performance assessment program component was totally performance based with the baseline being that none of the professors had used performance assessment before. See each individual knowledge assessment analysis below.

Table B.2.1: Program Knowledge Content Assessments

	Administration 1		Administration 2		Administration 3	Administration 4
See pages noted for each analysis below on following pages.	Statistically Significant Gain (.05)		Statistically Significant Gain (.05) or performance		Statistically Significant Gain (.05)	
Orientation (p.2)	Baseline		Yes		NA	Yes
Course Analysis (p.3)	Baseline		Yes		NA	NA
Student Learning Outcomes (p.4)	Baseline		Yes		Yes	NA
Test Analysis (p.5)	Baseline		Knowledge increased, but not statistically sig. -No		Yes and Performance	Yes and Performance
Performance Assessment (p.6-13)	There was no traditional pretest, as professors had not used performance tasks or rubrics-performance assessment; therefore, they designed and developed 3 complex tasks and corresponding rubrics. Baseline data was -0-		Yes, this was performance based assessment, thus no statistical analysis. A rubric with standards and criteria was used. Professors performed to the top criteria for each standard on the rubric.		None. However, the scored rubrics returned to each individual student in each of the professors' classes were reviewed to determine the quality of the scored rubrics and feedback to students. The rubrics were consistent in scoring and appeared to be done appropriately. Professors were so impressed with performance assessment, they all reported that they would continue to use it in the experimental course and their other courses as well.	NA
Educational Research (p.14)	Baseline		Yes		No	NA

Clearly, the chart above reveals that the CEET Faculty Development on Teaching and Learning resulted in knowledge gain by the professors on teaching and learning. For individual data analyses, see each description below:

DISCUSSION OF PROFESSORS' CONTENT KNOWLEDGE ON PROGRAM ORIENTATION CONCEPTS

(see Program A.5; Instruments in C.1; Worksheets in C.1 - Scarborough)

Jerry Gilmer, Ph.D.

An assessment of the professors' general knowledge of the concepts covered during the program orientation was administered prior to the orientation on 2/2/06 and again after the orientation on 2/16/06. On Orientation Day, the Faculty Development Program was fully explained as well as the learning process to be used throughout the Program. The process of analysis, active, problem-centered, and performance based learning was described. Concepts, primary theories, and expected products were explained (e.g., Teaching Portfolios). Some of the primary theories or concepts introduced were learning styles, teaching models and styles, performance assessment and rubrics, test analysis and development. There was a strong emphasis on the Scholarship of Teaching and the National Call for Action by the Carnegie Foundation and Boyer (1990) for research on teaching and for educational research to count as scholarship alongside the other three types of scholarship – also explained. The argument about what professors are supposed to do, teach or research was mentioned. In addition, the concepts of Faculty Learning Communities and Circles were introduced and explained. The assessment was intentionally subjective and short answer so professors could express in their own words what they absorbed. The maximum number of points from the assessment is 23. The table below contains the professors' scores for both administrations of the assessment.

Table B.2.a.1

	Admin 1 (2/2/06)	**Admin 2 (2/16/06)**
Abdel-Motaleb	0	10
Azad	6	12
Coller	9.5	11
Gupta	1	6
Moraga	2	3.5
Rahn	5.5	13.5
Tatara	2	8
Mean =	3.71	9.14
SD =	3.39	3.52

The differences between the means across all seven professors from the different administration times were analyzed statistically and the results are presented in the table below. The significance levels are from a paired samples t-test on the data from seven professors (df = 6).

Table B.2.a.2

	Mean	**SD**	**Difference From Admin 1**	**Sig. Level**
Admin 1 (2/2/06)	3.7	3.4	--	**--**
Admin 2 (2/16/06)	9.1	3.5	5.4	**.004**

The data in the table indicate that the increase in scores between the two administrations was *statistically significant* at the .05 level of significance.

DISCUSSION OF PROFESSORS' CONTENT KNOWLEDGE ON COURSE ANALYSIS

(see Program A.5; Instruments in C.2; Worksheets in C.1 - Scarborough)

Jerry Gilmer, Ph.D.

An assessment of the professors' general knowledge of the concepts of Course Analysis was administered prior to the presentation of the concepts on 2/2/06 and again after the presentation of the concepts on 2/16/06. The Course Analysis process involved the professors in analyzing their courses and instructional practices for a wide variety of factors. They performed analyses to determine the quality of their course content (e.g., concepts, theories, information, and skills; underlying math and science requirements or general education needed to be successful in their course, and whether the content was factual, conceptual, procedural, or meta-cognitive). This aspect of the analysis also involved them in comparing the content to the ABET/NAIT standards and examining their course objectives and outcomes. The course content was prioritized into three categories, primary, secondary, and important to mention; they reconsidered or added a course timeline or schedule. Furthermore, the professors then analyzed their courses for instructional practices or teaching models and styles and student learning styles to determine their primary practices, determining what could be changed. They also analyzed their courses using Dale's Cone of Learning and Bloom's Taxonomy of Learning to determine the level of engaged or active learning as well as attempt to determine levels of critical thinking involved. The result was a GAPs Analysis Summary showing current course reality and identifying a wide realm of changes that could occur. Finally, another aspect of the analysis process was to examine their student learning assessments, identifying strengths and weaknesses through test analysis and then making the decision to add performance tasks and rubrics. This program component assessment was also subjective short answer to provide opportunity for professors to express what they absorbed in open-ended expression. The maximum number of points from the assessment is 12. The table below contains the professors' scores for both administrations of the assessment.

Table B.2.b.1

	Admin 1 (2/2/06)	**Admin 2 (2/16/06)**
Abdel-Motaleb	3	3.5
Azad	2	7
Coller	4.5	6
Gupta	4	4
Moraga	1	3
Rahn	5.5	9
Tatara	6	8
Mean =	3.71	5.79
SD =	1.82	2.34

The differences between the means across all seven professors from the different administration times were analyzed statistically and the results are presented in the table below. The significance levels are from a paired samples t-test on the data from seven professors (df = 6).

Table B.2.b.2

	Mean	**SD**	**Difference From Admin 1**	**Sig. Level**
Admin 1 (2/2/06)	3.7	1.8	--	**--**
Admin 2 (2/16/06)	5.8	2.3	2.1	**.019**

The data in the table indicate that the increase in scores between the two administrations was *statistically significant* at the .05 level of significance.

DISCUSSION OF PROFESSORS' CONTENT KNOWLEDGE ON
STUDENT LEARNING OUTCOMES
(see Program A.5; Instruments in C.2; Worksheets in C.1 - Scarborough)
Jerry Gilmer, Ph.D.

An assessment of the professors' general knowledge of the concepts in Student Learning Outcomes was administered three times: prior to the presentation of the concepts on 3/23/06, after the presentation of the concepts on 5/15/06, and again at the conclusion of the program training sessions on 5/24/06. This program component engaged the professors in further analysis of their current course student learning objectives or outcomes. This involved them in identifying the appropriate ABET/NAIT standards and then in the development of student learning outcomes. As part of the learning process, the history of learning objectives, outcomes, behavioral objectives, etc., and the language and definitions leading up to the use of learning outcomes were presented so the engineering and technology professors could grasp the meaning and controversy more deeply. Although another subjective and open-ended short answer assessment, the assessment did require them to try to remember some definitions and meanings. The maximum number of points from the assessment is 13.5. The table below contains the professors' scores for both administrations of the assessment.

Table B.2.c.1

	Admin 1 (3/23/06)	Admin 2 (5/15/06)	Admin 3 (5/24/06)
Abdel-Motaleb	2	4.5	7.5
Azad	1.5	5	4
Coller	2	10	9
Gupta	5.5	6	6.5
Moraga	1.5	4	4
Rahn	5.5	9.5	11.5
Tatara	4	9.5	10.5
Mean =	3.14	6.93	7.57
SD =	1.82	2.64	2.96

The differences between the means across all seven professors from the different administration times were analyzed statistically and the results are presented in the table below. The significance levels are from paired samples t-tests on the data from seven professors (df = 6).

Table B.2.c.2

	Mean	SD	Difference From Admin 1	Sig. Level
Admin 1 (3/23/06)	3.1	1.8	--	**--**
Admin 2 (5/15/06)	6.9	2.6	3.8	**.006**
Admin 3 (5/24/06)	7.6	3.0	4.4	**.003**

The data in the table indicate that the increase in scores between the first administration and the other two administrations was *statistically significant* at the .05 level of significance.

DISCUSSION OF PROFESSORS' CONTENT KNOWLEDGE ON TEST ANALYSIS

(see Program A.5- and Instruments in C.2 - Gilmer)

Jerry Gilmer, Ph.D.

A knowledge test covering the test analysis content was administered to the professors four times: immediately prior to the test analysis teaching sessions (2/16/06), immediately after the test analysis sessions (3/30/06), immediately after the conclusion of the formal teaching sessions (5/15/06), and at the end of the semester during which the professors where practicing the concepts learned (12/15/06). A short review of the test analysis content occurred just prior to the administration of the test on 5/15/06. The maximum number of points from the test is 10. The table below contains the professors' scores for each administration of the test.

Table B.2.d.1

	Admin 1 (2/16/06)	Admin 2 (3/30/06)	Admin 3 (5/15/06)	Admin 4 (12/15/06)
Abdel-Motaleb	3	4	7	4
Azad	3	7	4	6
Coller	2	10	10	8
Gupta	4	4	7	7.5
Moraga	6	3	7	7
Rahn	2	10	8	8
Tatara	5	6	5	8
Mean =	3.6	6.3	6.9	6.9
SD =	1.5	2.9	1.9	1.5

The differences between the means across all seven professors from the different administration times were analyzed statistically and the results are presented in the table below. The significance levels are from paired samples t-tests on the data from seven professors (df = 6).

Table B.2.d.2

	Mean	SD	Difference From Admin 1	Sig. Level
Admin 1 (2/16/06)	3.6	1.5	--	**--**
Admin 2 (3/30/06)	6.3	2.9	2.7	**.134**
Admin 3 (5/15/06)	6.9	1.9	3.3	**.025**
Admin 4 (12/15/06)	6.9	1.5	3.4	**.005**

The data in the table indicate that, although the professors' knowledge in test analysis concepts increased from the first administration to the second, the increase was *not statistically significant* at the .05 level of significance. However, the professors' knowledge gains after the 5/15/06 review and after they had an opportunity to apply the knowledge in their own classrooms were statistically significant compared to the first, pre-teaching, administration.

DISCUSSION OF PROFESSORS' CONTENT KNOWLEDGE ON PERFORMANCE ASSESSMENT
PERFORMANCE TASK AND RUBRIC DEVELOPMENT
(see Program A.5 and Instruments in C.2 - Scarborough)
(pages 6-13; Educational Research follows on page 14)
Jule Dee Scarborough, Ph.D.

The learning and professional growth on the Performance Assessment program or knowledge component was measured by the professors' performance on the task of designing and developing three complex performance tasks and three corresponding rubrics for scoring task achievement. Using the Rubrics below as guiding criteria, they each designed three complex performance tasks and corresponding rubrics. These assessments were added to their course as new assessment strategies and assessment procedures.

It is important to note that one performance task/rubric was designed to correspond with the midterm and another to correspond with the final exam using the logic that objective tests usually reflect what students know or know about rather than what they can do. Therefore, we used an unusual scenario where the professors "linked" the objective midterm exam to a midterm performance task/rubric and an objective final exam to a final performance task/rubric. They also developed a third performance task/rubric and choose how and when to use it. They were asked to "match" where they thought the test items and performances "overlapped" and measured the same or similar content. It was assumed from studying the literature that performance assessment measures different aspects of learning, sometimes deeper levels of learning through use of knowledge in more active or engaging ways, problems, projects, etc. But performance assessment can also measure some of the same aspects of learning as objective tests. Also some of the professors designed their tests to incorporate some level of performance in subjective or problem-based items. In examining the tests and analyzing them, the objective items were separated from the more performance-based items. Professors were provided a presentation about Performance Assessment. Performance Tasks and Rubrics were discussed, and they received a portfolio of sample tasks and rubrics. They were given books on the topic as part of their new library on teaching and learning.

Their performance tasks and rubrics reflect the ABET or NAIT standards with corresponding rubrics. Perhaps one professor had used simple and less formalized rubrics before, but none of the professors had developed or used formal, written, scenario-based performance tasks with corresponding rubrics before this initiative. Thus, there were no previous instruments to view from the baseline semester, Fall 2005, and compare to these. Therefore, we judged them based upon the Rubrics below.

Performance Task: Design and develop three complex performance tasks with corresponding rubrics. The tasks must be based upon the ABET outcomes or NAIT standards and corresponding student learning outcomes for the course; they must also reflect real world, authentic performances or tasks in the appropriate community of practice, e.g. industry. The performance tasks and rubrics must be used to measure student learning

in the experimental research course, Fall 2006. See the **Rubrics** below for the achievement criteria to use in accomplishing the task.

Professors' Performance: The professors accomplished the performance task well. The process involved drafting initial and authentic real world scenarios with embedded task clusters and a corresponding rubric instrument for each task (3). The program leader provided feedback one-on-one as the performance tasks were developed. The professors shared their drafts with each other and benefited from the group critique process. The group process worked especially well. The tasks and rubrics were finalized; the program leader approved them; and then, each professor used the tasks and corresponding rubrics successfully with students during the 2006 experimental research semester. After the semester was completed, the professors copied all rubrics returned to each student in their classes for all three performance tasks. The program leader reviewed the scored/with comments rubrics that each student received back from the professors. Thus, the use of the rubrics was also reviewed. Finally, the professors completed a feedback/evaluation form about the use of performance assessment for the first time. As with test analysis and development, the feedback from the professors on the value of learning to design, develop, and use performance tasks/rubrics was extremely positive.

The following rubrics were used to guide the professors in the development of the three performance tasks and corresponding rubrics for each task.

Also, the feedback and evaluation questionnaire and professor responses are provided below, following the rubrics. The faculty members truly felt that expanding their assessments to include performance tasks with rubrics was extremely positive. They all indicated that they will continue to use performance assessment, tasks and rubrics, and also expand the use of performance assessment to other courses.

Rubric for Assessing the Quality of a Performance Task

Key Components - Properly Designed Performance Tasks must

- **I. Be based on content standards established by ABET or NAIT**
- **II. Describe a "real-life" scenario; are real world, authentic tasks; require active performances**
- **III. Involve students in complex reasoning – critical thinking at upper levels of Bloom's Cognitive Dimension**
- **IV. Require students to collect and process information, using it for an authentic purpose**
- **V. Incorporate "habits of mind"**
- **VI. Require student collaboration and cooperation; incorporates "individual" and "group" learning and performance accountability**
- **VII. Result in a tangible product and/or communication activity**

For each component, there are descriptors reflecting levels of achievement possible:

I. The Performance Task is based on the ABET or NAIT standards

a. The Performance Task is directly related to the ABET or NAIT standards.
b. Learning standards are apparent, but the relation to the task and/or national standards is sketchy or not apparent.
c. The Performance Task does not appear to be based on the standards/outcomes, course or national.

II. The Performance Task describes a "real-life" scenario that is authentic and requires active performance.

a. The scenario described in the task accurately mirrors an activity in the community of practice outside the classroom.
b. The scenario described in the task simulates an activity in the community of practice outside the classroom.
c. The scenario described in the task contains some aspects of activity outside the classroom but is largely contrived.
d. The scenario described in the task is an academic exercise that usually takes place only in the context of an academic setting.

III. The Performance Task involves students in complex reasoning-critical thinking processes at upper levels of Bloom's Cognitive Dimension.

a. The task requires students to utilize complex reasoning – critical thinking skills, such as induction/deduction, diagnosis, abstracting, experimental inquiry, problem solving; evaluation, creation, synthesis, etc.
b. The task requires students to utilize complex reasoning components, such as comparing, classifying, decision making, or investigation.
c. The task requires students only to recall facts.

IV. The Performance Task requires students to collect and process information, using it for an authentic purpose.

a. The task incorporates a variety of information gathering techniques and information resources. Students are required to interpret and synthesize information and accurately assess the value of information gathered. They are required to collect the right information for an authentic purpose, e.g. solve a problem, apply or use in a complex project, etc.
b. The task requires students to gather and synthesize information, but the value of the information gathered is not assessed. Information may not be used for a purpose.
c. The task requires the students to gather information, but not to interpret it.
d. The task requires no gathering or processing of information.

V. The Performance Task incorporates "Habits of Mind."

a. The task requires students to make effective plans, use necessary resources, evaluate effectiveness of their own actions, seek accuracy, and engage in activities when answers or solutions are not immediately apparent.
b. The task only requires students to effectively plan or use resources.
c. The task does not require students to engage in self-regulation, critical, or creative thinking.

VI. The Performance Task requires student collaboration and cooperation; incorporates "individual" and "group" learning and performance accountability.

a. The task requires students to use interpersonal skills, work toward the achievement of team goals, and perform a variety of roles within the team. There is a formal team structure and process.
b. The task requires students to work together in teams but there are no measures described that ensure collaboration or cooperation among team members.
c. The task is completed largely by students on an individual basis rather than in student teams.

VII. The Performance Task results in a tangible product and/or communication activity.

a. The task result is a tangible product or communication activity comparable to that commonly produced in business or industry community of practice.
b. The task results in a product that is similar to those completed in business or industry community of practice, but lacks several components that make the product realistic.
c. The task does not result in a product or communication activity relevant to a business or industry community of practice.

(Scarborough, 2006 [Based upon White & Scarborough, 2004])

Rubric for Assessing the Quality of a Rubric

Properly Designed Rubrics Must

- **I. Contain a set of key components/standards to be assessed that reflect the student learning outcomes for the course, which are directly linked to the national outcomes.**
- **II. Include descriptors for each component/standard that are measurable.**
- **III. Have descriptors-criteria that are indicative of observable student performances or behaviors.**
- **IV. Incorporate a clear and well-defined scoring system**
- **V. (Optional) Include appropriate weights for each component and descriptor**

For each component, there are descriptors reflecting levels of achievement possible:

I. The rubric contains a set of key components (standards) to be assessed.

a. A complete list of key components-standards is provided for the performance task, including the embedded subtasks, if a cluster. The task(s) are directly connected to student learning outcomes for course and the national outcomes.
b. Key components/standards listed are not exhaustive for the performance task and/or subtasks embedded are not clear enough for student response or action; components or standards are not clearly connected to student learning outcomes for course.
c. Not all key components/standards describe student outcomes; some are not directly linked to national outcomes.
d. No key components are listed.

II. The rubric includes a set of descriptors-criteria for each key component or standard.

a. Descriptors-criteria for each component or standard are arranged in a clear hierarchy from non-achievement to full-achievement.
b. Descriptors-criteria are present for each component/standard, but obvious levels in some are missing.
c. Each component does not have an associated set of descriptors-criteria.

III. The rubric descriptors/criteria are clear and contain observable or measurable student performances or behaviors.

a. All descriptors-criteria clearly delineate levels of observable student performances or behaviors.
b. Most descriptors-criteria clearly delineate levels of observable student performances or behaviors.
c. Only a few descriptors-criteria clearly define levels of observable student performances or behaviors.
d. Descriptors-criteria do not describe observable student performances or behaviors.

IV. **Incorporate a clear and well-defined scoring system**

a. There is a well defined and clear system for scoring each component-standard and its descriptors-criteria. Points or percentages are assigned appropriate to instructional and performance values.
b. The scoring system lacks definition, clarity, and although there is a scoring system, some aspects are ambiguous, subjective or unclear.
c. There is no scoring system.

V. Optional: Appropriate weights are assigned to components and descriptors.

a. Component-standards and descriptors-criteria are each properly weighted according to instructional emphasis and performance values.
b. Weights are assigned, but point values do not reflect proper instructional emphasis or performance values in all cases.
c. Weights are assigned to some performance standards and descriptors, but not others.

(Scarborough, 2006 [Based upon White & Scarborough, 2004])

CEET Initiative on Teaching and Learning - Performance Assessment Feedback, Jan, 2007

(7/7 respondents)

1. Was the time spent developing <u>performance</u> <u>tasks</u> worth your time – worthwhile?

(7) Yes Not really

Why?

- *"A lot of work, but they really engage students"*
- *"Allowed me to think about what students should be able to perform after completing the course."*
- *"Invaluable." "Although I always give 'projects', I was naïve to many of the aspects of a true performance task."*
- *"Performance tasks made students (1) solve open ended problems; (2) work in groups; (3) identify problems and try to have multiple solutions and then justify the solution."*

2. Was the time spent developing <u>rubrics</u> for scoring the performance tasks worth your time – worthwhile?

(7) Yes Not really

Why?

- *"Students knew what was expected of them; grading was a bit easier; fewer students challenged their grades."*
- *"Allowed me to set expectations from the PAs."*
- *"The students really responded well to them! They liked knowing the expectations for performance tasks."*
- *"I didn't have this experience before."*
- *"Rubrics helped students understand what is expected of them and how they will be graded."*

3. Would you <u>recommend</u> the <u>performance task</u> program content for other faculty members?

(7) Yes Not really

Why?

- *"Valuable"*
  "It will be a good exercise for others."
- *"I think any new faculty should be exposed to this experience."*
- *"I feel students learned a lot because of the performance tasks."*

4. Would you <u>recommend</u> the <u>rubric</u> program content for other faculty members?

(7) Yes Not really

Why?

- *"It will be a good exercise for others."*
- *"This, I believe, is a necessity."*

5. Were the <u>performance</u> <u>tasks</u> a <u>beneficial</u> addition to the student assessment plan for your course?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
  "Provides additional form of assessment method."
- *"It added a new dimension of student assessment; also these performances tasks involved various learning styles."*

6. Were the <u>rubrics</u> <u>beneficial</u> for scoring the performance tasks?

(7) Yes Not really

Why?

- *"Students knew what was expected of them; grading was a bit easier; fewer students challenged their grades."*
- *"Makes the scoring process easier."*
- *"It made it easier for me – and the students also responded well. IT is necessary to have a procedure mapped out for them to understand the expectations and levels."*
- *"They make grading progress easier."*
- *"Otherwise, it would be very subjective or arbitrary."*

7. Were the <u>performance</u> <u>tasks</u> an <u>effective</u> tool for <u>enhancing</u> student learning?

(7) Yes Not really

Why?

- *"Bigger, more authentic tasks."*
- *"Students can demonstrate what they can perform after completing the course."*
- *"(1)It allowed for many more teaching styles to be incorporated in the course; (2) more learning styles were also included; (3) a good tool for group work as well."*
- *"They really understand expectations."*
- *"Students' learning involves various learning and teaching style, and models and performance tasks provided these opportunities."*

8. Were the <u>performance</u> <u>tasks</u> an effective tool for <u>measuring</u> student learning?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Students can demonstrate what they can perform after completing the course."*
- *"(1) It demonstrated their abilities to communicate effectively; (2) It demonstrated their abilities to synthesize, apply, and evaluate subject matter content."*
- *"Students' learning may not be completely assessed by only exams and homework."*

9. Were the <u>rubrics</u> an <u>effective</u> tool for <u>scoring</u> the outcomes of student performances on the tasks?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"See previous comments."*
- *"Rubrics provide the details of expected outcomes."*

10. Were the <u>rubrics</u> <u>effective</u> in helping students to <u>understand</u> <u>more</u> about what you expected them to do by revealing the standards and scoring mechanism with them up front?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Students know the expectations."*
- *"See previous comments."*
- *"They know what is expected of them."*

11. Do you feel that more <u>formalized</u> <u>performance</u> <u>tasks</u> and rubrics <u>improve</u> the opportunity for students to provide <u>evidence</u> of learning?

(6) Yes (1) Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Not everyone is good in taking tests. Also exams and homework do not provide the opportunity through performance tasks."*
- *"Two is enough."*

12. Would you recommend that other faculty members get the opportunity to learn to develop and use performance tasks and rubrics as student assessment tools?

(7) Yes Not really

Why?

- *"I believe this was one of the most beneficial aspects of the program with regard to student learning and assessment. It ties in with active learning and Bloom's Taxonomy."*
- *"It was a big help for me."*

13. Was the performance/rubric development process used with this group – *"developing while learning from presentation, examples, and one-on-one feedback"* - effective?

(7) Yes Not really

Why?

- *"One-on-one feedback especially helpful."*

14. Will you continue to use performance tasks and rubrics in this and/or other classes?

(7) Yes Not really

Why?

- *"To improve student learning."*

15. Strengths of the performance task/rubric program component.

- *"Already stated in above [responses]."*
- *"Measures what students can really perform with their learned tools."*
- *"Quantified student performance; gave students guidance and goals."*
- *"I liked the development of the Performance Tasks, especially with the rubric. Discussions were enlightening, as well as our group discussions and evaluations."*
- *"Very good way in presenting material; Different styles of rubrics presented; also working in our same classes helped to learn how to do rubrics and performances."*
- *"Provide other teaching styles, learning styles, and teaching models."*
- *"Allow for active learning. Results show improvement when Performance Tasks were done in groups."*

16. Areas to improve in the performance task/rubric program component.

- *"Revisit and revise."*
- *"None."*
- *"Streamline the time scale."*
- *"Good as is."*

17. General comments:

- *"This part was exceptional—I will always use this info in my classes in the future."*
- *"Very good program."*

"Results indicate conclusively that learning level was enhanced [by students in experimental

DISCUSSION OF PROFESSORS' CONTENT KNOWLEDGE ON EDUCATIONAL RESEARCH

(see Program A.5 and Instruments in C.2 - Gilmer)

Jerry Gilmer, Ph.D

A knowledge test covering research topics was administered to the professors three times: immediately prior to the research teaching sessions (5/25/06), the same day immediately after the research sessions (5/25/06), and at the end of the semester during which the professors were practicing the concepts learned (12/15/06). The maximum number of points from the test is 14. The table below contains the professors' scores for each administration of the test.

Table B.2.f.1

	Admin 1 (5/25/06)	**Admin 2 (5/25/06)**	**Admin 3 (12/15/06)**
Abdel-Motaleb	0	9	8
Azad	2	5	3
Coller	7	11	11
Gupta	5	14	9
Moraga	8	9	6
Rahn	--	--	11
Tatara	5	11	7
Mean =	4.5	9.8	7.9
SD =	3.0	3.0	2.9

The differences between the means across the professors from the different administration times were analyzed statistically and the results are presented in the table below. The significance levels are from paired samples t-tests on the data from six professors (df = 5).

Table B.2.f.2

	Mean	**SD**	**Difference From Admin 1**	**Sig. Level**
Admin 1 (5/25/06)	4.5	3.0	--	**--**
Admin 2 (5/25/06)	9.8	3.0	5.3	**.010**
Admin 3 (12/15/06)	7.3	2.7	2.8	**.095**

The data in the table indicate that the increase in the professors' knowledge on research topics from the first administration to the second was statistically significant beyond the .05 level of significance. However, the professors' knowledge tended to decline slightly during the semester in which they were applying the knowledge in their own classrooms, rendering the difference between Admin 1 and Admin 3 not statistically significant.

CEET FACULTY DEVELOPMENT PROGRAM
FEEDBACK AND EVALUATION FROM PARTICIPATING PROFESSORS
(see Research in A.3, Program in A.5 and Instruments in C.2 - Scarborough)
Jule Dee Scarborough, Ph.D.

The CITL Faculty Development Program was extremely demanding, time consuming, and work oriented. The faculty members were expected to learn, analyze, perform, and produce educational products as well as make instructional decisions about educational processes, models and techniques as they participated. The program was interactive and integrated, actively engaging the professors while learning. To perform to the level that this group did exhibited great commitment to teaching and learning, both for themselves and their students. It also clearly showed commitment to their respective departments and the college, and especially to each other as colleagues. Their feedback was positive, constructive, and well-intentioned. Their comments on each feedback form reveal suggestions that are worth considering for the next stage of the program. Very important to note is the respect, friendly manner, and consideration that they showed to the program leaders. They were colleagues and professionals in every sense. (Note: See individual feedback summaries that follow.)

Program feedback and evaluation was a variable in the research and evaluation design to determine program success. The professors provided feedback after each program segment. For some segments, that was one day; however, for other segments, the number of days could vary from three to five. The only segment where the feedback was not collected at the immediate end was the performance assessment component. However, they completed that at the January 2007 meeting, which turned out to be more beneficial, as the results of the feedback incorporated how professors' felt about their performance tasks and rubrics after they were used with the students. Although a very great majority of the responses to items and the comments were very positive, there were comments or suggestions to consider for improving the program or professors' willingness to participate.

Topics of Interest for Further Study

1. More on Educational Research – beyond superficial to engage in more depth
2. Additional time on Cooperative Learning – deeper level
3. Additional topic on Student Teaming – student team development, team work, and grading
4. Program component on Conflict Management for Students - civility in the classroom; classroom management

A summary of each feedback form, with all comments and notations, follows on the chart below for the entire program. However, to review each individual program component summary, see pages:

1-12 for the end-of-research semester and final program feedback and evaluation (Dec.06)
13-16 for the end of program feedback and evaluation (May, 2006)
17-20 for the Performance Assessment feedback (Jan. 2007)

See pages 21-30 for the feedback summaries on each individual program component. All are summarized on the chart in Table 1 below.

Table B.3.1: Summary – February 2006– January 2007

	Prompted Responses Very Positive	Constructive Comments: Usually, these comments were made by the same one individual throughout the feedback process.	Comments Very Positive with few exceptions
Orientation (2/2/06)	X	**Lots of definitions that do not mean much.** [*This seems to have changed as a result of the program*.]	X
Course Analysis (2/9/06)	X	No considerations	X
Test Analysis (2/16/06)	X	No considerations	X
Student Learning Outcomes (3/2/06 & 3/23/06)	X	No considerations	X
Test Development (3/30/06 – 4/27/06)	X	No considerations	X
Performance Assessment & Rubrics (12/06)	X	No considerations	X
End of Program (5/15/06 – 5/25/06)	X	**The Big Picture. Would be useful if the program was laid out at the beginning.** [*We really did this but believe because the words and educational terminology had little meaning to the participants, full understanding of what was explained did not occur. This can be modified to assist better understanding. Also because the program leaders had no idea what would be required to move the group toward achievement of program goals, the exact steps could not be identified until tried and adjusted to fit group.*] **One individual commented on the avalanche of learning materials and suggested to start small and then expand to reduce confusion and being overwhelmed**. [*It is true, they left the program with a complete toolbox of books, articles, and other materials,(e.g. many rubric examples, etc.). We assumed they would be more likely to continue if they had the resources at their fingertips. So in trying to provide a complete toolbox, we knew it would be somewhat overwhelming, and it was. However, we can suggest improvements for managing so many different resources and materials for the next group.]* **Incorporate small, interlinked lectures over a period of workshops with examples**. [*This is really what we did, so do not know how to change this*.]	X

		Make a series of small, interlinked workshops over time. [*We did this the first half of program – 9 days beginning in February and ending in April, but then finished the program with two whole weeks of consecutive days in May, so professors could finish during intersession. The two weeks were very productive, but very intense and focused. The quality of work was excellent for both schedules, one day at a time and the block of consecutive days.]*	
End of Program After Research Semester (12/15/2006 and 1/30/2007)	X	**Program time commitment was mentioned related to the number of days, hours, and hours per day.** [*We agree that 18 days is probably unheard of nationally, but the program was intentionally designed for breadth and some depth. One of the most important factors on time in the program was that time was allowed for professors to actually design, develop, and produce the educational products for their courses, make instruction choices about new models and processes, and plan how to use them, etc. This takes time. This was not a" talk and walk" program, leaving the follow-through to the professors. It carried them from analysis to experimental research in their classroom, analysis after that semester, and manuscript production*.] **One individual felt that faculty should have time off to take the course.** [*These are interesting comments, as the Dean allowed us to use "in-semester" work days for half the program, even though faculty members were paid a stipend of $5000. The other half was summer time. We felt professors were financially rewarded well, as teaching is fully part of their job responsibility*] **Compensation level: one individual thought it should be higher**. [*Each faculty member received $5000; we felt they were well rewarded, plus resources, materials, and the Dean permitted use of semester days for one half of program, not all summer.*] **One individual commented that this program is best for faculty members with very positive attitudes; otherwise, one or two with more negative mindsets would drag the rest down.** [*We provided several different perspectives about students. One professor was fairly negative about students and their commitment to learning; however, generally, I do not believe we really had any negative faculty members. We had strong personalities, differences of opinions, and a variety of philosophies about teaching and students. Thus the group was rather diverse in many ways, ethnicity, cultures, disciplines, one female participant, the principal leader was female, but no one in the group was negative.*]	X

		It is possible that one or more very negative individual(s) could have diverted program time; however, when those individuals are included and ultimately buy in, they are the best advertisement and motivators towards sustainability. So we agree, but would not have chosen only positive individuals intentionally; however, the Dean did select individuals he thought would be willing to commit to such an extended program. **One individual commented that maybe workshops in the program should be given out of town to reduce interference with other normal job tasks.** [*There were very few interruptions; some at first while getting used to the program, process, work pace, lab, and delivery schedule; for example, one professor would be interrupted by his research assistant on the cell phone. But once the workshop operational standards were made clear – no interruptions unless absolutely necessary, our professors showed up on time and worked hard until the day ended with very few interruptions. We tried to accommodate various lunch time preferences, as there were prayer time preferences and family lunch times to consider; this did not present any problems. If anyone did not quite finish the day's work, they were expected to be ready for the next session with work in hand. That did not always happen; one felt that he was not getting paid for 'out-of-class' work, but overall the pace among professors worked for the most part. That one individual did not really understand that teaching IS part of his job from the perspective that any time preparing for class – the whole program – was his responsibility. This individual performed well.* **To end with a professor's quote:** **"It [Teaching and Learning – research on TL] is a fantastic area, rich with opportunities for grants/research papers."**	

CEET Initiative on Teaching and Learning (7/7 present)
Final Program Feedback - December 15, 2006

1. Looking back, and after the research semester, do you feel that the faculty development sessions were worth your time – worthwhile?

-Course Analysis: e.g., content gap analysis & priority, learning styles, teaching models & styles, standards & learning objectives/outcomes, objectives and test item match, Bloom's Taxonomy, Dale's Cone, Critical Thinking, and more	Yes (6) Majority (1)
Not really	
-Test Analysis and Test Development Review	Yes (6) Majority (1)
Not really	
- Performance Assessment and Rubics	Yes (6) Majority (1)
Not really	
-Analyzing all your assessments by Bloom	Yes (6) Majority (1)
Not really	
- Consideration of "broader" assessments and mapping your assessments	Yes (6) Majority (1)
Not really	
-Teaching Models, including Cooperative Learning and Mapping Analysis	Yes (6) Majority (1)
Not really	
-The review of components for a more revealing syllabus for the students	Yes (6) Majority (1)
Not really	
-The review and consideration of Multicultural aspects of courses.	Yes (3) Majority (2)
Not really(1)	
-The review and consideration of grading.	Yes (3) Majority (4)
Not really	
-The educational Research Session	Yes (4) Majority (3)
Not really	

-Overall, was the faculty development program worth your time & "worthwhile"? Yes (6) Majority(1) Not really

****Why or Why not to any of the above statements?

- *"I really liked the content. However, it was an enormous time commitment, which made it very difficult"*
- *"The addition of rubrics had a tremendously positive impact"*
- *"Gained an appreciation for educational research and the power it holds"*
- *"Test analysis was very useful; I will continue to use it."*
- *"Wish we had more on cooperative learning/team dynamics"*
- **"***This was the best faculty development program that I had participated in at NIU. The program addressed all aspects of a course development, course analysis, test analysis, test development, and modifying a course in an organized manner. Also using assessment as a process for continuous improvement."*
- *"It was worth the time & 'worthwhile' because it:*
  (i) introduced me to various concepts, styles, etc. that are typically considered only by people in colleges of education
  (ii) introduced new dimensions to the course by considering broader assessments as well as evaluation of assessment (rubrics)
  (iii) improved learning of students thru better syllabus (content and relationship to SLO –student learning objectives), etc."
- *"More Research sessions would have been desirable (I want to learn more)"*
- *"More time on topics like Multicultural aspects, Applications of Teaching Models, Cooperative Learning, etc. would be recommendable"*
- *"I personally missed the topic of keeping civility in the classroom or throughout the semester."*
- *"This course exposed me to new types of knowledge; I could not know this if I did not take this course or it is unlikely to know this knowledge on my own."*

2. Would you recommend the overall program, including the program content as you experienced it, for other faculty members?

Yes, definitely (3) Yes, the greater majority of it (4) Some of it Not really

****Why or why not?

- *"Only for faculty members with* <u>very</u> *positive attitudes and open minds. Negativity, even among just a few members, can drag the rest down. I think a less ambitious workshop might be more effective because participants won't feel as constrained by time."*
- *"Yes, I strongly believe that other faculty members should be exposed to this kind of program. This kind of activity will improve the overall teaching quality of CEET."*
- *"It would help faculty members to improve their courses, which would eventually lead to better prepared students."*
- *"I think the program is good for instructors [professors] like us, who don't have background in these matters"*
- *"Setting needs to be different. May be the course should be given in a workshop form out of town to reduce interfering with other normal job tasks"*

3. Looking back at the semester, were the modifications made to your course or the changes to your course worthwhile and effective with students?

Yes, definitely-they improved the course and instruction (3)

Yes, the majority of them improved the course and instruction (2)

Yes, some of them improved the course and instruction (1)

Not as many of the changes were as valuable as I had hoped (1)

No, very few of them were successful changes

****Why or Why not?

- "*Every course is different. Hence the course materials should be customized for the individual course. But this course should be given to professors as is because it exposes them to all techniques"*
- *"I think the success of these methods depends also on students. That component is critical – orientation for students on these issues would be great"*
- *"Through improved syllabus, performance assessments, etc."*
- *"In terms of the students for the target course, it was too many changes within one semester. Considering the course delivery methods for [???] program, this course delivery was a major shift. So it was little difficult for the student to grasp all the benefits"*
- *"Much better organized; much better assignments. Much better tests."*
- *"The tight deadlines for course content do not always work, especially in a senior level course and especially when students bring in new topics, ideas that they would like to discuss"*

4. Were the teaching and learning materials developed during the faculty development sessions effective when used with students during the research semester?

Yes, definitely (1)

Yes, greater the majority of them (5)

Yes, some of them (1)

Not as many of the materials were as valuable as I had hoped

No, very few of the materials were successful

****Why or Why not?

- *"See above" ["Every course is different. Hence the course materials should be customized for the individual course. But this course should be given to professors as is because it exposes them to all techniques"]*
- *"I had to design additional assignments for my class"*
- *"The materials developed were very much useful, as I have used them for the course without spending much time during the semester"*
- *"The rubrics for the performance tasks were excellent"*
- *"The overall course organization was also beneficial"*

5. Describe how you feel about the "products" you have developed, their purpose, usefulness, quality, etc.?

Analysis products – gaps analysis, teaching models and styles analysis, learning styles analysis, course content Analysis

- **"***I guess it was nice to see, but I think I knew instinctively what it was"*
- *"Very Good"*
- *"Useful exercise"*
- *"Useful"*

Syllabus –

- *"This was good, although it didn't have as big of an impact as other aspects"*
- *"V. good"*
- *"It was good"*
- *"Very Good"*
- *"Essential product"*
- *"Useful"*
- *"Very useful - I do not like the tight deadlines though"*

Tests –

- *"I really appreciate the diagnostic info I get from my revised test(s)"*
- *"Excellent"*
- *"Good"*
- *"Convenient for test preparation"*
- *"Useful"*
- *"The multiple choice t/f questions did not seem to work well→ I will keep my "short answer" type"*

Test Analyses -

- **"***I really appreciate the diagnostic info I get from my revised test(s)"*
- *"Good"*
- *"This was very helpful to me"*
- *"Very Good"*
- *"Provides understanding about a test"*
- *"Useful"*
- *"Very beneficial"*

Performance Assessments -

- *" PA#2 and PA#3 were the best learning experiences, I think, for the student's → high impact"*
- *"Very Good"*
- *"Was good"*
- *"Very Good"*
- *"Useful"*
- *"Excellent!"*

Rubrics –

- *"I had rubrics before. Now they're a bit better"*
- *"V. good"*
- *"Was good"*
- *"Very Good"*
- *"Convenient for scoring"*
- *"Excellent value"*
- *"Excellent!"*

Choices of teaching models and processes –

- *“Mixing it up was good.”*
- *“Good”*
- *“I would like to continue using collaborative learning styles”*
- *“Good”*
- *“Most were useful”*
- *“Very useful → I liked using the KOLB inventory with the students; they had a good response to this activity”*

6. **Was the Research Semester, performing experimental classroom research with students, worth your time and “worthwhile”?**

- *“yes”*
- *“yes, very valuable”*

Yes, very valuable, beneficial in the following ways:

__(5) provided evidence of the benefit of the course, teaching, learning, content, test, etc. gaps analyses and what was learned from them and developed as a result of identifying the gaps through the analysis processes

__(7) provided opportunity to evaluate and see benefits of new teaching and learning or educational products

__(7) provided opportunity to evaluate and see benefits of new teaching and learning processes

__(6) provided opportunity to evaluate and see benefits of new teaching models and styles

- *“very valuable”*

__(7) provided insight into student learning

__(7) provided insight about my teaching

- *“let me know that some of what I was doing had a name; opened my eyes to new ideas”*

__(6) provided opportunity for a first attempt at educational research – scholarship of teaching

- *“this is invaluable - I will definitely pursue this”*

__(1) identify and list others:

- *“interesting, fun”*

Not really as valuable as I had hoped: describe why for each item below:

____ provided evidence of the benefit of the course, teaching, learning, content, test, etc. gaps analyses and what was learned from them and developed as a result of identifying the gaps through the analysis processes

____provided opportunity to evaluate and see benefits of new teaching and learning or educational products

____provided opportunity to evaluate and see benefits of new teaching and learning processes

____ provided opportunity to evaluate and see benefits of new teaching models and styles

____provided insight into student learning

____provided insight about my teaching

____provided opportunity for a first attempt at educational research – scholarship of teaching

__(2) identify and list others:

- *"Cooperative learning, team, leadership → I would like to study these areas more (need more time)"*
- *"Looking at the data now, I wish I had designed some parts of the experiment better."*

7. Would you recommend to other faculty members that they begin to engage in research on teaching and learning?

Yes, definitely (7)   Yes, definitely, but after participating in the faculty development to prepare them

No, not really

*******Why? Specifically, what would keep you from recommending that others engage in classroom research on teaching and learning? Please describe in detail.**

- *"Because it provides a source of information that rarely is available to people in profession other than teachers."*
- *"I think this is a very good policy of the college"*
- *"This will improve overall quality of teaching for our CEET."*

8. From the perspective of the entire program (faculty development, the development of course and classroom materials, and the educational research semester) was the entire program - beginning with analysis through classroom research as a "whole" program, worth your time – worthwhile?

Yes (6)   The greater majority (1)   Some of it   Really, Not much

******Specifically, Why or Why not?**

- *"It is a unique chance to learn this type of knowledge."*
- *"Even though I have taught this course many time before, it allowed me to evaluate the course from a completely new perspective and improve upon it"*
- *"I now have a better understanding about how students learn and how I can improve my courses through properly organized teaching."*
- *"It was such a big time commitment, that I can't say yes completely."*
- *"It is important to take our jobs as educators seriously→"*
- *"We should strive for continuous process improvement/lifelong learning ourselves"*
- *"It is a fantastic area rich with opportunities for grants/research/papers"*

9. Would you recommend that other faculty members get the opportunity to participate in this "whole" program, including faculty development, course development, and classroom research ?

Yes, definitely (4)   Yes, with a few content changes (3)   Yes, with many content changes?
No, not really

10. Specifically, what content changes would you suggest?

- *"More cooperative learning"*
- *"Less time on the syllabus timeline"*
- *"As I said before, I think a less ambitious approach might be more effective. E.g. Just one performance assignments…I'm not sure where to cut. Syllabus?"*
- *"Exposed them slowly to program"*
- *"Introduce aspects of civility in class room."*
- *"How to manage conflicts."*
- *"See above"*

11. Was the learning and development "process" used during the entire program (Oct.05-research, Dec.06) effective?

Yes, definitely (5) Yes, with a few process changes (1) Yes, with many process changes
No, not really No response (1)

****Why?

- *"I think I learned certain important issues on education that will help me to improve."*
- *"Covered a lot of material with hands-on experience"*

12. Specifically, what process changes would you suggest? ****Why?

- *"Have workshop days not be always so work intensive – these were very draining and it took time to recover"*
- *"I sincerely think the way instructors file materials from us should change.- I feel like they ask us too many times the same information"*
- *"Faculty should have time off to take the course. This is a huge task that cannot be added to the heavy load of faculty."*

13. Specifically, what about the program, overall, would keep you from recommending it to other faculty members?

Describe in great detail.

- *"The time commitment – it was very intense"*
- *"Faculty should know the complete program plan at the very beginning"*
- *"It should be recommended to any faculty who is very committed to put lot of time and energy, open to new ideas and concepts and eventually improve the course"*
- *" →Everything was good"*
- *"All"*

14. Identify and/or describe the teaching and learning changes that you implemented in the research semester's course:

____ (6) Improved priority of course content

____ (7) New syllabus with many new components

____ (7) Clear learning objectives/outcomes tied to ABET/NAIT standards

- "Very Useful!!!"

____ (7) Learning Style Inventory (e.g. Kolb, Felder, other)

____ (7) New teaching models

- (4) Small groups

- *"mixing inductive/deductive"*
- *"included more group discussion"*
- "Included more group discussion and small group encounters"

- One minute papers

____ (7) New teaching styles

____ (7) New objective tests

____ (7) New performance assessments/rubrics

____ (6) New grading criteria – clear and pre-determined, no curving of grades, or last minute non-criteria-based judgments, etc.

____ (6) Better alignment of syllabus, teaching, and assessment.

____Identify and list others specific to you.

15. Do you feel that the program dates worked…recall that some time was spent during the regular semesters and some time during the summer; specifically there was ½ or 9 days across the regular semesters and ½ or 9 days in May, plus 2 fall meetings, and the final meeting?

Worked well (5)   Would prefer a different schedule (1)   No response (1)

****Describe a preferred schedule for 18 days, plus several short meetings

- *"Should be given during breaks"*
- *" Just a bit overwhelming"*

16. Describe the strengths of the overall program content.

- *"Everything is good"*
- *"Help faculty who are not familiar with educational research"*
- *"Covers all aspects of teaching, assessment, evaluation, and course development"*
- *"I loved doing the research"*
- *"Excellent exposure to the whole idea of the scholarship of teaching"*
- *"Many excellent ideas for course improvement"*
- *"Introduce "civility" and "conflict' issues in [program] contents"*

17. Describe the strengths of the overall learning and development process.

- *"Results in better learning for students"*
- *"Definitely, I think this is a good program for the college!"*
- *"Teaching and Learning Style"*
- *"Constructivism"*

18. Describe the areas you would like to see improvements in regarding the overall program content AND specify the desired improvements.

- *"None that I can think of. Only suggestion – that faculty should be allowed to adjust the grading cut offs based on difficulty of questions in tests."*
- *"[Add] Coop Learning, Team Concepts, Leadership*
- *"Already stated"*
- *"Timing – load management. Compensation."*

19. Describe the areas to you would like to see improvements in related to the overall learning and development process AND specify the desired improvements.

- *"It was very good."*
- *"Ditto"*

20. Dean Vohra would like your Learning Community to continue and actively involve each of you together to continue to learn, share, and execute research on teaching and learning. At this point, although we don't have it well defined, are you willing to help define what "continued action" means and then continue to participate?

Yes, definitely (7) *"Very good idea"* No, probably not – Why?

Describe for you.

21. Other General Comments about the overall program:

- *"Thank You. I will retain this info forever and expand upon it."*
- *"Thank you very much. It was a wonderful experience."*

CEET Initiative on Teaching and Learning
Program Feedback- Final Feedback – May 15-25 & Overall (7/7 present)

1. Were the sessions May 15-25 worth your time – worthwhile?

Test Analysis and Development Review	(7)	Yes	Not really
Performance Assessment and Rubics	(7)	Yes	Not really
Analyzing all your assessments by Bloom	(7)	Yes	Not really
Consideration of "broader" assessments and mapping your assessments	(7)	Yes	Not really
Teaching Models, including Cooperative Learning and Mapping Analysis	(7)	Yes	Not really
The review of components for a more revealing syllabus for the students	(7)	Yes+(1)	Not really
The consideration of Multicultural aspects of courses.	(7)	Yes	Not really
The consideration of grading.	(7)		
The Research Session	(6)	Yes	(1)Not really

Why?

- *"Most of the information provided are/seems to be useful."*
- *"I think we should assess whether it can be simplified at all. It was exhausting."*
- *"Some like grading and multicultural issues were not addressed earlier. Also analyzing my course in terms of Bloom, teaching models, etc. made me appreciate various techniques of learning."*
- *"I think the Research Session was really good. But, I feel the Research Session should have had more time to really understand what we are going to do in our class in fall."*

2. From the perspective of the entire program, was it as a "whole" worth your time – worthwhile?

(7) Yes Not really

Why?

- *"It was a good introduction in two areas: a) How to plan, analyze, and update a course as a continuous process and (b) Basics of educational research."*
- *"Only if they are sufficiently open-minded and care/interested enough about teaching/learning to put in the effort."*
- *"Hopefully students will learn more due to better analysis and delivery of course."*
- *"Opened my eyes to a whole new area- definitely improvements can be made in the classroom armed with this new knowledge."*

3. Would you recommend the overall program content as you experienced it for other faculty members?

(6) Yes (1) Not really

Why?

- *"Invaluable"*
- *"I prefer to try some of these techniques in one of my classes and evaluate their impact. This will allow me to have a credible standpoint."*
- *"See above"*
- *"Because it will improve the learning of students. However, some faculty may not be open to change."*
- *"It seems to me that our college should implement this workshop as a "must" policy for every faculty. For that way, we'll make sure students will receive a homogeneous "product" from all [faculty?]"*
- *"One thing I would change is to start small then expand. Providing avalanche of materials caused a lot of confusion to me. May be start with one learning set first."*

4. Would you recommend that other faculty members get the opportunity to participate in this program with content modifications?

(7) Yes Not really – too soon to determine

What changes would you suggest?

- *"Make a series of small and interlinked workshops over the period of time. This will allow them to digest the material and introduce changes in a progressive way."*
- *"A bit intense"*
- *"However, it should be tried out first half next semester before it is recommended for other faculty."*
- *"I would incorporate more lectures in middle of sessions with examples."*
- *"The handouts of material were sometimes overwhelming. I would reduce this."*
- *"Less time*

5. Was the learning and development "process" used during the entire program (including the May 15-25 time) effective?

(7) Yes Not Really

Why?

- *"The program was intensive and structured and the tutors [program leaders]have personal background of using the techniques for their own courses. Personal experience of the tutor [program leader] made the program credible one."*
- *"Yes, but handouts are too much to handle"*

6. Describe how you feel about the "products" you have developed, their purpose, usefulness, quality, etc.?

- *"I feel proud. I am amazed at the amount of work accomplished. Quality is excellent, usefulness is invaluable"*
- *"Excellent"*
- *"I think my products in this workshop are of good quality, for me, they will be of great help in fall. I feel I have good material"*
- *"Very good"*
- *"They are the result of a lot of effort"*
- *"The products that I have developed are useful items towards the proposed course. However, they need to be revisited before they can be used for the class."*

7. Describe teaching and learning process differences that you will implement in next fall's course?

- *"Definitely will include more active learning, more discussion groups, less "lecture"*
- *"Will use performance tests, collaborative learning, improved"*
- *"I will use more active learning, but now I feel I know how to proceed to make this more productive. I will also incorporate collaborative methods."*
- *"Use various teaching styles, models; be aware of Bloom's levels [of learning]"*
- *"Much more active and hands-on. More collaborative."*
- *"The course will be much more learner and assessment centered."*

8. Do you feel that the program dates worked…meaning some semester time and some summer time; our time was ½ days (9) in semester and ½ days (9) in May.

(7) Worked well   Would prefer a different schedule.

Describe a preferred schedule for 18 days.

- *"It was long, but by restructuring the course the # of days can be reduced."*
- *"For me, worked well."*
- *"However, shorter days would be preferred"*
- *"Worked well…the distribution was good. The intensity and time commitment was high."*
- *" However, last two weeks was very intense. More days could be used during the semester time."*

9. Strengths of the program overall.

- *"A plethora of useful information"*
- *"Real work was accomplished as evidenced by our "products"*
- *"Good discussion with fellow faculty members."*
- *"Presented teaching and learning in a scientific way."*
- *"It provides a great deal of information and knowledge about what we are supposed to be and how we are supposed to act as educators"*
- *"Good understanding of education principles"*
- *"So much interesting stuff to think about"*
- *"Experience of the tutors [program leaders]"*
- *"Program structure"*

10. Strengths of the learning and development process overall.

- *"See Above"*
- *"I think it worked well, but I feel – as I commented above, the material was handed out in an overwhelming manner- (even though I know the reasons). But this could go against the learning process."*
- *"It worked for me"*
- *"Mixture of lecture, group work, and individual work"*

11. Areas to improve the overall program.

- *"Time needed was enormous – needs to be shortened"*
- *"See 3"*
- *"I would incorporate a little bit more lectures (short) on some topics and examples"*
- *"Shorter days. Fewer content (e.g. only one taxonomy for teaching styles. Higher compensation considering the time required"*
- *"Mentioned above"*
- *"It would be useful if all the steps of the program could be made available at the very beginning. Such as course analysis, course development, educational research, and subsequent long-term plan. In that case, participants would have much better commitments"*

12. Areas to improve the learning and development process overall.

- *"I would incorporate a little bit more lectures (short) on some topics and examples"*

13. Dean Vohra would like the your Learning Community to continue and actively involve each of you together to continue to learn, share, and execute research on teaching and learning. At this point, although we don't have it well defined, are you willing to help define what "continued action" together mean and then continue to participate?

(7) Yes   No, probably not

- *"Yes, definitely"*
- *"Maybe it will be a good idea to let the community grow on its own. While administration can play the role of a facilitator."*

14. Did you learn or enhance "other" types of skills through the program process (e.g. computer or others)?

- *"No"*
- *"No"*
- *"Not much"*

15. General Comments about the overall program:

- *"Excellent – thank you for allotting me this opportunity!"*
- *"It was a good program to enhance my effectiveness as a teacher."*
- *"Excellent"*
- *"My overall comments are that this was a very good and enriched experience and definitely will help me to improve my teaching as well as professionally and personally."*
- *"Good. However, instead of focusing on terminologies, focus primarily on the outcome of this program."*
- *"Mentioned above"*

CEET Initiative on Teaching and Learning - Performance Assessment Feedback, Jan, 2007

(7/7 respondents)

1. Was the time spent developing <u>performance</u> <u>tasks</u> worth your time – worthwhile?

(7) Yes Not really

Why?

- *"A lot of work, but they really engage students"*
- *"Allowed me to think about what students should be able to perform after completing the course."*
- *"Invaluable." "Although I always give 'projects', I was naïve to many of the aspects of a true performance task."*
- *"Performance tasks made students (1) solve open ended problems; (2) work in groups; (3) identify problems and try to have multiple solutions and then justify the solution."*

2. Was the time spent developing <u>rubrics</u> for scoring the performance tasks worth your time – worthwhile?

(7) Yes Not really

Why?

- *"Students knew what was expected of them; grading was a bit easier; fewer students challenged their grades."*
- *"Allowed me to set expectations from the PAs."*
- *"The students really responded well to them! They liked knowing the expectations for performance tasks."*
- *"I didn't have this experience before."*
- *"Rubrics helped students understand what is expected of them and how they will be graded."*

3. Would you <u>recommend</u> the <u>performance task</u> program content for other faculty members?

(7) Yes Not really

Why?

- *"Valuable"*
  "It will be a good exercise for others."
- *"I think any new faculty should be exposed to this experience."*
- *"I feel students learned a lot because of the performance tasks."*

4. Would you <u>recommend</u> the <u>rubric</u> program content for other faculty members?

(7) Yes Not really

Why?

- *"It will be a good exercise for others."*
- *"This, I believe, is a necessity."*

5. Were the <u>performance</u> <u>tasks</u> a <u>beneficial</u> addition to the student assessment plan for your course?

(7) Yes   Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
  "Provides additional form of assessment method."
- *"It added a new dimension of student assessment; also these performances tasks involved various learning styles."*

6. Were the <u>rubrics</u> <u>beneficial</u> for scoring the performance tasks?

(7) Yes   Not really

Why?

- *"Students knew what was expected of them; grading was a bit easier; fewer students challenged their grades."*
- *"Makes the scoring process easier."*
- *"It made it easier for me – and the students also responded well. IT is necessary to have a procedure mapped out for them to understand the expectations and levels."*
- *"They make grading progress easier."*
- *"Otherwise, it would be very subjective or arbitrary."*

7. Were the <u>performance</u> <u>tasks</u> an <u>effective</u> tool for <u>enhancing</u> student learning?

(7) Yes   Not really

Why?

- *"Bigger, more authentic tasks."*
- *"Students can demonstrate what they can perform after completing the course."*
- *"(1)It allowed for many more teaching styles to be incorporated in the course; (2) more learning styles were also included; (3) a good tool for group work as well."*
- *"They really understand expectations."*
- *"Students' learning involves various learning and teaching style, and models and performance tasks provided these opportunities."*

8. Were the <u>performance</u> <u>tasks</u> an effective tool for <u>measuring</u> student learning?

(7) Yes   Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Students can demonstrate what they can perform after completing the course."*
- *"(1) It demonstrated their abilities to communicate effectively; (2) It demonstrated their abilities to synthesize, apply, and evaluate subject matter content."*
- *"Students' learning may not be completely assessed by only exams and homeworks."*

9. Were the <u>rubrics</u> an <u>effective</u> tool for <u>scoring</u> the outcomes of student performances on the tasks?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"See previous comments."*
- *"Rubrics provide the details of expected outcomes."*

10. Were the <u>rubrics</u> <u>effective</u> in helping students to <u>understand</u> <u>more</u> about what you expected them to do by revealing the standards and scoring mechanism with them up front?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Students know the expectations."*
- *"See previous comments."*
- *"They know what is expected of them."*

11. Do you feel that more <u>formalized</u> <u>performance</u> <u>tasks</u> and rubrics <u>improve</u> the opportunity for students to provide <u>evidence</u> of learning?

(6) Yes (1) Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Not everyone is good in taking tests. Also exams and homework do not provide the opportunity through performance tasks."*
- *"Two is enough."*

12. Would you <u>recommend</u> that other faculty members get the opportunity to learn to develop and use performance tasks and rubrics as student assessment tools?

(7) Yes Not really

Why?

- *"I believe this was one of the <u>most</u> beneficial aspects of the program with regard to student learning and assessment. It ties in with active learning and Bloom's Taxonomy."*
- *"It was a big help for me."*

13. Was the performance/rubric development process used with this group – *"developing while learning from presentation, examples, and one-on-one feedback"* - effective?

(7) Yes Not really

Why?

- *"One-on-one feedback especially helpful."*

14. Will you <u>continue</u> to use <u>performance</u> <u>tasks</u> and <u>rubrics</u> in this and/or other classes?

(7) Yes Not really

Why?

- *"To improve student learning."*

15. Strengths of the performance task/rubric program component.

- *"Already stated in above [responses]."*
- *"Measures what students can really perform with their learned tools."*
- *"Quantified student performance; gave students guidance and goals."*
- *"I liked the development of the Performance Tasks, especially with the rubric. Discussions were enlightening, as well as our group discussions and evaluations."*
- *"Very good way in presenting material; Different styles of rubrics presented; also working in our same classes helped to learn how to do rubrics and performances."*
- *"Provide other teaching styles, learning styles, and teaching models."*
- *"Allow for active learning. Results show improvement when Performance Tasks were done in groups."*

16. Areas to improve in the performance task/rubric program component.

- *"Revisit and revise."*
- *"None."*
- *"Streamline the time scale."*
- *"Good as is."*

17. General comments:

- *"This part was exceptional—I will always use this info in my classes in the future."*
- *"Very good program."*
- *"Results indicate conclusively that learning level was enhanced [by students in experimental semester]."*

(6 Present; 1 absent)

CEET Initiative on Teaching and Learning
Item Writing and Test Development – Days 6, 7, 8, 9 – March 30, April 6, 20, 27

1. Were these four days worth your time – worthwhile?

5 Yes 2 No Response No, not really

Why?

- *"Thought a lot about testing (productively)"*
- *"Made me develop the tests based on SLOs"*

2. Did the presentation and handouts provide appropriate information to guide you in item writing and test development without overwhelming you with too much material?

6 Yes 1 No Response No, not really

Why?

3. Were you able, during the four sessions, to write many appropriate and valid test items and to assemble what you would consider good tests or tests more fully developed than the ones you were using before now?

4 Yes 1 written response only 1 No Response No, not really

Why?

- *"Not nearly enough. It takes a long time to draw [figures]"*
- *"Because we had to write objective test items"*

4. As a result of these four sessions do you now feel you have greater ability and confidence in writing items and developing tests?

6 Yes 1 No Response No, not really

Why?

- *"Exam/test preparation will be much more structured."*

5. Would you recommend that other faculty members have the opportunity to learn more about writing items and developing tests through workshops similar to these?

4 Yes 2 No Responses 1 No, not really

Why?

- **"***too soon to use until we finish our program and further explore its meaning."*

6. Was the "process" used during these days effective?

5 Yes 1 No Response 1 Written Response Only No, not really

Why?

- *"I came up with a lot more item ideas today, now that I had to put test together. Perhaps could infuse some of today's content earlier."*

7. **Strengths of this aspect of the progra**m.
    - "*Item Bank will be useful for the coming years.*"
    - "*Forces faculty to analyze the course content and tests in great detail.*"
    - "*Made it clear how you can make a fair test.*"

8. **Areas to improve in this aspect of the program.**

9. **General Comments:**
    - "*Make it 10-3 so that other dept. business can be attended before and after workshop.*"

CEET Initiative on Teaching and Learning
Student Learning Outcomes – Days 4 & 5, March 2 & 23 (7/7 present)

1. Were these two days worth your time – worthwhile?
Yes 7/7 Not really

Why?

- *"Never thought so deeply about outcomes. To be honest, I thought more about other courses than this one."*
- *"Really magnified the usefulness of the techniques."*
- *"Analyze SLO in more detail."*
- *"The SLO will help students to understand what they are going to learn."*

2. Would you recommend the program content on Student Learning Outcomes for other faculty members?
Yes 5/7 Not really 1/7 "Not at this stage." Skipped Question 1/7

Why?

- *"Same" ("Never thought so deeply about outcomes. To be honest, I thought more about other courses than this one."*
- *"It is useful to focus on SLO to ensure course content and exam matches with [each other?]."*

3. Did the presentation and handouts provide appropriate information to guide you in the development of student learning outcomes without overwhelming you with too much material?

Yes 6/7 No, not really 1/7

Why?

- *"Presentation was confusing-so much terminology for more or less the same thing. Paper-splitting hairs it seems."*
- *"Not much of a presentation today. But thought was useful from last time."*

4. Did the "student learning outcome" sessions help you to specify the knowledge, skills, and ability course content more clearly and to identify priorities more logically?

Yes 7/7 0/7 No, not really

Why?

- *"I had already done a pretty good job of content identification and prioritization."*
- *"However, I would complement it with looking at other complete examples."*
- *"Ensure appropriate issues related to knowledge, issues, etc. are addressed."*
- *"Although I had much of it [in] my head-I had not translated it to 'paper' or organized it fully."*

5. Did the "student learning outcome" session help you to develop new or enhanced student learning objectives?

6/7 Yes, they are more… (select all that apply) 1/7 Not really

1/7 a. intentional in content and result or outcome
1/7 b. results oriented - outcomes oriented in that they clearly state what students are to know about, know, or be able to do
1/7 c. specific in what knowledge, skill, ability is to be learned or extended by the student
1/7 d. measurable
e. observable
1/7 f. appropriately stated - using more definite verbs and nouns; they explain the purpose, provide context, situation, conditions, etc.
5/7 g. all of the above
1/7 no selections (responded Yes above)

Why?

- *"Not so much for the specific course, more for another course I'm teaching. Exercise brought organizational clarity."*

6. In completing the calendar for the formal scheduling of course content, there is greater potential to (select all that apply)

1/7 a. enhance or improve the course focus
1/7 b. provide a better format for on-going critical analysis of the course content as updates or changes are needed
1/7 c. enhance or improve the course content delivery
1/7 d. help me better visualize my course and how to continuously update, improve or enhance it to continuously increase student learning
1/7 e. provide the students with a clearer picture of the course and what they are to learn
1/7 f. help me and my students to stay on "course"
6/7 g. all of the above

Why?

7. Now that you have written student learning outcomes, do you feel more able to prepare learning activities or experiences?

5/7 Yes 1/7 [wrote in Somewhat] 0/7 No, not really

Why?

- *"Not so much for my course. More for another course."*

8. Would you recommend that other faculty members get the opportunity to engage in revising their course Student Learning Outcomes - content identification and student learning outcomes?

5/7 Yes 2/7 No Response 0/7 Not really

Why?

- *"Mentioned above 'Not so much for this course. More for another course.'"*
- *"Too soon to use until we finish our program and further explore its meaning"*

9. Was the "process" used during these days effective?

6/7 Yes 1/7 No Response 0-/7 Not really

Why?

10. Strengths of this aspect of the program.

- *"It's worth the time so far."*
- *"Really aided in focusing our efforts to see an improved end."*
- *"Was able to identify where the breakdown is in communication between faculty and students."*

11. Areas to improve in this aspect of the program.

12. General Comments:

- *"Great!"*
- *"Excellent day"*

NOTE: Only 6/7 respondents as one member had to leave as feedback forms were handed out.

CEET Initiative on Teaching and Learning
Gap Analysis Summary and Test Analysis Feedback- Day 3 – Feb. 16, 2006

1. Was today worth your time – worthwhile?
Yes 6/6 Not really

Why?

- *"I really liked the analysis of tests"*
- *"Learned how to analyze the test, like discrimination indexes"*
- *"Allow to understand test profile"*
- *"Test stats interesting"*

2. Would you recommend today's content for other faculty members?
Yes 5/6 1/6 Not really

Why?

3. Did the GAPs Analysis & Summary help you to see possibilities for extending or enhancing: course content and teaching/learning strategies. Also did it make you <u>aware</u> of models and techniques that you could <u>consider</u> using to build or extend student learning experiences to higher levels of learning?
Yes 6/6 Not really

Why?

- *"More insight into course delivery"*
- *"I essentially did this last week. I guess the new form that organized info differently was good" [relates to GAP summary]*
- *"This will help to incorporate additional activities within the class"*

4. Would you recommend that other faculty members get the opportunity to engage in the preliminary aspect of test analysis?
Yes **5/6** 1/6 Not really – too soon to use until we finish our program and further explore its meaning

Why?

- *"Could be valuable"*

5. Was the "process" used today effective?
Yes 6/6 Not really

Why?

- *"Contains both activity and lecture"*

6. Strengths of today's program.

- *"analysis of tests"*
- *"hands on"*
- *"excellent ways to look @ test from a deeper perspective"*
- *"working with real data"*

7. **Areas to improve today's program.**
    - *"Most of concepts are useful. However, learning styles probably have best usefulness because no matter what is the type of student, the concept needs to be taught"*
    - *"Most test analysis we discussed seemed to be geared toward tests with many questions…But my test(s) have few questions"*
    - *"none"*

8. **General Comments:**
    - *"I feel today I learned something very important to analyze my teaching work.-It is always difficult to analyze tests, but today was a super important class for me in that sense"*
    - *"none"*

NOTE: Only 6/7 participants provided feedback.

CEET Initiative on Teaching and Learning
Analysis Feedback- Day 2

1. Was today worth your time – worthwhile?

Yes-6/6 Not really

Why?

- "*It forced us to take a hard look at the current state of our courses"*
- *"got an understanding of what I was doing"*
- *"I liked dissecting the course"*
- *"dissed the conpe" [I think is] "discussed the course"*

2. Would you recommend today's content for other faculty members?

Yes – 5/6 Not really 1/6 ("May Be")

Why?

- *"valuable"*
- *"dissect their course" [I think is] "discussed the course"*

3. Would you recommend that other faculty members get the opportunity to engage in this preliminary analysis?

Yes – 5/6 *"If there is an opportunity"* Not really -- 1/6 (*too soon to use until we finish our program*)

4. Was the "process" used today effective?

Yes -5/6 Not really 1/6

Why?

- "*systematic*
- "*you may use the O.H. projector to explain what should be done" approach"*
- "*though, still I have some things not too clean" [finish probably]*
- "*worked at own pace"*

5. Strengths of today's program.

- "*Looking at various aspects of learning and teaching"*
- "*Well thought"*
- "*The approach [I think] to work on our own task"*
- "*Good flow; materials provided were easy to understand; excellent input from Jule"*
- *"Hands on"*

6. Areas to improve today's program.

- *"There could be an example case to illustrate the process"*
- "*I would like to know how to apply the 'Reversed Instructional Design Method" [I think]*
- *"I wish I would have known about forms→I would have brought my laptop"*
- *"I'm one of those learners who likes to see big picture before. It's slowly coming into focus"*
- *"Do as last time. Use O.H."*

7. General Comments:

- "*Very productive day"*

CEET Initiative on Teaching and Learning
Orientation Feedback Summary (8/8 present)
Feb. 2, 2006

Feedback inquiries will change across the different types of modules with some constant items. However, both content assessment and quality feedback instruments will be used throughout the program. Below is a summary of faculty feedback offered by participants for the one-day orientation session.

1. Was today worth your time -- worthwhile?

Yes 8/8 Not really

Why?

- *"Got me interested in learning more about assessment"*
- *"New ideas brought to light"*
- *"It helped realize where I should improve"*
- *"Force to think how to improve teaching"*
- *"Laid a background for the program"*

2. Would you recommend today's content for other faculty members?

Yes 6/8 Not really 1/1 and 1/1 "not at this point"

Why?

- *"Can really broaden perspectives"*
- *"Not a whole lot of substance today"*
- *"It helps in developing good teaching capabilities"*
- *"Help them also on how to improve teaching"*

3. Will the survey data be a useful guide for instructional decision-making?

Yes 8/8 Not really

Why?

- *"Can get a baseline"*
- *"I think it might"*
- *"to identify strengths and weaknesses"*
- *"Even though it should be corrected by the number of students answered each question"*
- *"will help me to plan my course"*

4. Would you recommend that other faculty members get the opportunity to use the student survey?

Yes 5/8 and 1/8 Not really 1/8

Why?

- *"Yes, but maybe wait"*
- *"Too soon to use until we finish our program and further explore its meaning"*
- *"I'm not sure it's valuable yet"*

5. Was the "process" used today effective?

Yes 7/8 Not really 1/8

Why?

- *"Learn[ed] detailed analysis of teaching"*
- *" for an introduction, group discussion was very informative"*

6. Strengths of today's program.

- *"The data generated from the survey has helped us understand our teaching and improve on them"*
- *"Good organization"*
- *"Everything"*
- *"New teaching methods discussed"*
- *"Instructors. I think they are prepared to conduct this initiative and I look forward to learning how to improve my teaching skills"*
- *"Individual and group discussion"*
- *"Got me interested in learning more about assessment"*
- *"Good overall overview & objectives presented"*

7. Areas to improve today's program.

- *"Allowing more time for reviewing the survey result"*
- *"Can't say yet"*
- *"Good as is"*
- *"Reduce lunch time & get out early"*
- *"None"*
- *"First half of day: Lot's of definitions that don't mean a whole lot"*

8. General comments:

- *"I'm excited, I see so much potential"*
- *"None"*
- *"Good group to work with"*
- *"Excellent workshop"*
- *"I think this is something very important for faculty members, specially those that are just starting"*

RESULTS: END-OF-COURSE QUESTIONNAIRE AND STANDARD EVALUATIONS

(See Program A.5- and Instruments in C - Scarborough)

Jule Dee Scarborough, Ph.D. and Jerry Gilmer, Ph.D.

A questionnaire was developed to assess the students' and professors' perceptions of the overall quality of instruction, course content, and the learning environment across the college (Scarborough, 2006). The questionnaire included questions about different areas of instruction such as course objectives and testing activities. The instrument was completed along with the regular end-of-course evaluations of instruction in the professors' classes at the end of the Fall 2005 semester and again at the end of the Fall 2006 semester, and the data between the two years were compared. The questionnaire was from the perspective of the student and primarily intended for student feedback. However, we also used it with the professors and asked them to complete it from their perception of the students' perspective about their course, instruction, assessments, etc. It was interesting to compare the students' perceptions to the professors' perceptions of how the students might respond.

Important Note: Although many of the significance levels are less than .05 (a traditional indicator of statistical significance), due to the length and complexity of the questionnaire and the nature of the students' actual responses, the validity of the data might be questionable. The person scanning the answer sheets on which the students bubbled their responses provided the following warning: "I had a lot of trouble scanning these sheets because of multiple marks; just about half of the sheets were rejected by the scanner because of multiple marks where we were not expecting (or accepting) them. I found this with both the student and faculty groups. My impression is the people filling out this evaluation were not paying attention to what they were doing or not closely reading the questions and instructions. I also remember having the same problem with the sheets last December." In all cases where there appears to be statistical significance, the 2006 scores were higher than the 2005 scores. However, if the students are not paying attention to the actual questions and simply filling in bubbles on the answer sheet, the scores will tend to be higher than they would otherwise due to the scoring methodology.

Also Important Note: When we reported what the person scanning answer sheets indicated (above) to the professors and asked them about the questionnaire administration, they felt that it was administered the same as it was in the 2005 classes, that the time allocated was approximately the same, that the students did take it seriously, and that the students seemed to focus when completing it. They also felt that they, themselves, took it seriously and that they completed the questionnaire as they should have. They wondered why the person scanning did not mention his doubts about the 2005 questionnaire then, rather than now, and questioned memory as reliable. The professors all felt that the results for both the 2005 and 2006 questionnaires could be used without suspicion and that the results provided good information and feedback. A summary of the statistical significance levels for the scores from the professors, all students combined, and the cohort of students from each professor's class is presented in the table below.

See Instrument on pages 9-24 below. A copy without point values is in Volume III, Portfolio Section C.10

Table B.4.1: Statistical Significance Levels Comparing Scale Means Between Scores from Fall 2005- Fall 2006

	Results from All Professors and All Students		Results from Students in Each Professor's Class						
Content Area	**All 7 Professors**	**All Students**	**Ibrahim Abdel-Motaleb**	**Abul Azad**	**Briano Coller**	**Abhijit Gupta**	**Reinaldo Moraga**	**Regina Rahn**	**Robert Tatara**
Objectives & Syllabus Items (101-104)	**0.005**	**0.407**	**0.975**	**0.971**	**0.708**	**0.577**	**0.114**	**0.023**	**0.581**
Testing & Measurement Items (105-111)	**0.000**	**0.000**	**0.000**	**0.420**	**0.002**	**0.000**	**0.009**	**0.000**	**0.286**
Learning & Teaching Methods Items (112-117)	**0.010**	**0.000**	**0.001**	**0.150**	**0.210**	**0.008**	**0.134**	**0.000**	**0.222**
Cooperative & Group Learning Items (118-124)	**0.020**	**0.000**	**0.000**	**0.451**	**0.071**	**0.487**	**0.008**	**0.019**	**0.000**
Language Item (125)	**0.361**	**0.896**	**0.690**	**0.028**	**0.441**	**0.805**	**0.308**	**0.489**	**0.511**
All Engineering Courses Items (126-136)		**0.754**	**0.978**	**0.108**	**0.586**	**0.133**	**0.574**	**0.392**	**0.416**
Project Total Items (101-125)	**0.000**	**0.000**	**0.000**	**0.402**	**0.024**	**0.038**	**0.109**	**0.000**	**0.075**
Overall Total Items (101-136)		**0.000**	**0.000**	**0.418**	**0.044**	**0.019**	**0.099**	**0.001**	**0.050**

Shaded cells indicate statistical significance beyond the .05 level.

The following tables present the scale means and standard deviations for each scale separately for the professors' responses and for the students' responses.

Table B.4.2: Professors

Scale	Year	N	Mean	SD	Sig. Level
Objectives & Syllabus (101-104)	Fall 2006	7	18.9	1.3	**0.005**
	Fall 2005	7	15.6	2.1	
Testing & Measurement (105-111)	Fall 2006	7	21.4	2.2	**0.000**
	Fall 2005	7	13.4	2.3	
Learning & Teaching Methods (112-117)	Fall 2006	7	21.1	4.3	**0.010**
	Fall 2005	7	13.4	5.1	
Cooperative & Group Learning (118-124)	Fall 2006	7	14.6	3.9	**0.020**
	Fall 2005	5	6.6	6.2	
Language (125)	Fall 2006	7	3.6	0.5	**0.361**
	Fall 2005	7	3.1	1.1	
All Engineering Courses (126-136)	Fall 2006	0			
	Fall 2005	0			
Project Total (101-125)	Fall 2006	7	79.6	9.3	**0.000**
	Fall 2005	5	51.4	7.9	
Overall Total (101-136)	Fall 2006	0			
	Fall 2005	0			

Table B.4.3: Students

Scale	Year	N	Mean	SD	Sig. Level
Objectives & Syllabus (101-104)	Fall 2006	146	12.8	5.0	**0.407**
	Fall 2005	160	12.4	5.1	
Testing & Measurement (105-111)	Fall 2006	134	17.8	3.7	**0.000**
	Fall 2005	146	12.7	3.4	
Learning & Teaching Methods (112-117)	Fall 2006	129	16.8	7.6	**0.000**
	Fall 2005	138	12.5	5.9	
Cooperative & Group Learning (118-124)	Fall 2006	131	10.3	4.3	**0.000**
	Fall 2005	106	6.4	6.1	
Language (125)	Fall 2006	132	3.3	1.0	**0.896**
	Fall 2005	145	3.3	1.0	
All Engineering Courses (126-136)	Fall 2006	120	14.9	5.6	**0.754**
	Fall 2005	129	14.6	6.3	
Project Total (101-125)	Fall 2006	122	62.3	14.7	**0.000**
	Fall 2005	90	48.9	15.3	
Overall Total (101-136)	Fall 2006	113	78.1	17.1	**0.000**
	Fall 2005	82	62.4	17.0	

Table B.4.4: Professors – SPSS Output

Group Statistics

Scale	Year	N	Mean	Std. Deviation	Std. Error Mean
Objectives & Syllabus (101-104)	Fall 2006	7	18.8571	1.34519	0.50843
	Fall 2005	7	15.5714	2.14920	0.81232
Testing & Measurement (105-111)	Fall 2006	7	21.4286	2.22539	0.84112
	Fall 2005	7	13.4286	2.29907	0.86897
Learning & Teaching Methods (112-117)	Fall 2006	7	21.1429	4.29839	1.62464
	Fall 2005	7	13.4286	5.09435	1.92548
Cooperative & Group Learning (118-124)	Fall 2006	7	14.5714	3.86683	1.46152
	Fall 2005	5	6.6000	6.18870	2.76767
Language (125)	Fall 2006	7	3.5714	0.53452	0.20203
	Fall 2005	7	3.1429	1.06904	0.40406
All Engineering Courses (126-136)	Fall 2006	0			
	Fall 2005	0			
Project Total (101-125)	Fall 2006	7	79.5714	9.25306	3.49733
	Fall 2005	5	51.4000	7.89303	3.52987
Overall Total (101-136)	Fall 2006	0			
	Fall 2005	0			

Table B.4.5: Professors – SPSS Output

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Objectives & Syllabus (101-104)	Equal variances assumed	0.658	0.433	3.429	12	**0.005**	3.28571	0.95831	1.19773	5.37370
	Equal variances not assumed			3.429	10.076	0.006	3.28571	0.95831	1.15262	5.41880
Testing & Measurement (105-111)	Equal variances assumed	0.048	0.830	6.615	12	**0.000**	8.00000	1.20937	5.36500	10.63500
	Equal variances not assumed			6.615	11.987	0.000	8.00000	1.20937	5.36469	10.63531
Learning & Teaching Methods (112-117)	Equal variances assumed	0.005	0.943	3.062	12	**0.010**	7.71429	2.51931	2.22517	13.20340
	Equal variances not assumed			3.062	11.670	0.010	7.71429	2.51931	2.20789	13.22069
Cooperative & Group Learning (118-124)	Equal variances assumed	3.689	0.084	2.762	10	**0.020**	7.97143	2.88591	1.54122	14.40164
	Equal variances not assumed			2.547	6.219	0.042	7.97143	3.12986	0.37796	15.56489
Language (125)	Equal variances assumed	0.809	0.386	0.949	12	**0.361**	0.42857	0.45175	-0.55572	1.41286
	Equal variances not assumed			0.949	8.824	0.368	0.42857	0.45175	-0.59649	1.45363
All Engineering Courses (126-136)	Equal variances assumed	0.048	0.830	5.508	10	**0.000**	28.17143	5.11440	16.77584	39.56702
	Equal variances not assumed			5.669	9.564	0.000	28.17143	4.96903	17.03089	39.31197
Project Total (101-125)	Equal variances assumed	0.658	0.433	3.429	12	**0.005**	3.28571	0.95831	1.19773	5.37370
	Equal variances not assumed			3.429	10.076	0.006	3.28571	0.95831	1.15262	5.41880
Overall Total (101-136)	Equal variances assumed	0.048	0.830	6.615	12	**0.000**	8.00000	1.20937	5.36500	10.63500
	Equal variances not assumed			6.615	11.987	0.000	8.00000	1.20937	5.36469	10.63531

Table B.4.6: Students – SPSS Output

Group Statistics

Scale	Year	N	Mean	Std. Deviation	Std. Error Mean
Objectives & Syllabus (101-104)	Fall 2006	146	12.8493	4.98874	0.41287
	Fall 2005	160	12.3688	5.12439	0.40512
Testing & Measurement (105-111)	Fall 2006	134	17.8060	3.66548	0.31665
	Fall 2005	146	12.6507	3.44332	0.28497
Learning & Teaching Methods (112-117)	Fall 2006	129	16.7597	7.60425	0.66952
	Fall 2005	138	12.4638	5.94151	0.50578
Cooperative & Group Learning (118-124)	Fall 2006	131	10.2672	4.32137	0.37756
	Fall 2005	106	6.4151	6.12080	0.59450
Language (125)	Fall 2006	132	3.2879	0.96922	0.08436
	Fall 2005	145	3.3034	1.00225	0.08323
All Engineering Courses (126-136)	Fall 2006	120	14.8500	5.57553	0.50897
	Fall 2005	129	14.6124	6.31752	0.55623
Project Total (101-125)	Fall 2006	122	62.3443	14.74341	1.33481
	Fall 2005	90	48.9333	15.25793	1.60833
Overall Total (101-136)	Fall 2006	113	78.1062	17.13151	1.61160
	Fall 2005	82	62.4268	16.96185	1.87312

Table B.4.7: Students – SPSS Output

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Objectives & Syllabus (101-104)	Equal variances assumed	0.139	0.709	0.830	304	**0.407**	0.48057	0.57914	-0.65907	1.62020
	Equal variances not assumed			0.831	302.718	0.407	0.48057	0.57843	-0.65769	1.61882
Testing & Measurement (105-111)	Equal variances assumed	2.549	0.111	12.134	278	**0.000**	5.15529	0.42486	4.31894	5.99163
	Equal variances not assumed			12.102	272.016	0.000	5.15529	0.42600	4.31661	5.99396
Learning & Teaching Methods (112-117)	Equal variances assumed	8.252	0.004	5.162	265	0.000	4.29592	0.83225	2.65727	5.93458
	Equal variances not assumed			5.120	242.111	**0.000**	4.29592	0.83908	2.64309	5.94876
Cooperative & Group Learning (118-124)	Equal variances assumed	29.849	0.000	5.667	235	0.000	3.85208	0.67972	2.51297	5.19120
	Equal variances not assumed			5.470	182.766	**0.000**	3.85208	0.70426	2.46255	5.24161
Language (125)	Equal variances assumed	0.041	0.840	-0.131	275	**0.896**	-0.01557	0.11870	-0.24924	0.21810
	Equal variances not assumed			-0.131	273.987	0.896	-0.01557	0.11851	-0.24887	0.21773
All Engineering Courses (126-136)	Equal variances assumed	2.354	0.126	0.314	247	**0.754**	0.23760	0.75736	-1.25411	1.72930
	Equal variances not assumed			0.315	246.330	0.753	0.23760	0.75395	-1.24742	1.72261
Project Total (101-125)	Equal variances assumed	0.030	0.862	6.450	210	**0.000**	13.41093	2.07924	9.31208	17.50978
	Equal variances not assumed			6.416	188.166	0.000	13.41093	2.09008	9.28794	17.53392
Overall Total (101-136)	Equal variances assumed	0.087	0.768	6.335	193	**0.000**	15.67937	2.47493	10.79798	20.56075
	Equal variances not assumed			6.345	175.683	0.000	15.67937	2.47100	10.80270	20.55603

See Instrument on pages 9-24

TRADITIONAL END-OF-COURSE EVALUATIONS

Jule Dee Scarborough, Ph.D. and Jerry Gilmer, Ph.D

The traditional end-of-course evaluations were only indirectly related to the components and content of this project. For that reason and due to the number and variety of factors that can affect end-of-course evaluations, confounding year-to-year comparisons, no analyses involving these evaluations was performed.

It is suggested that in the round of classroom research that professors design the research to include the traditional course evaluation a
s a factor in the research.

Traditional end of course evaluations - Fall 2005

			Item											
		# of Sheets	1	2	3	4	5	6	7	8	9	10	11	**Average**
Ibrahim	Abdel-Motaleb	14	4.50	2.43	3.50	4.14	3.36	3.64	4.43	3.57	3.36	3.93	3.38	**3.66**
Abul	Azad	11	4.73	4.36	4.27	4.36	4.27	3.82	4.36	4.64	4.64	4.27	4.55	**4.39**
Brianno	Coller	54	4.83	4.23	4.25	4.53	4.02	3.52	4.57	4.72	4.62	4.17	4.54	**4.36**
Abhijit	Gupta	37	4.72	3.53	3.19	3.58	3.81	3.06	3.69	4.06	4.11	3.94	3.74	**3.77**
Reinaldo	Moraga	16	3.88	2.44	2.44	2.31	1.69	1.94	3.00	3.00	3.06	2.69	2.00	**2.59**
Regina	Rahn	16	4.88	4.44	4.31	4.31	4.50	4.21	4.75	5.00	4.94	4.38	4.56	**4.57**
Bob	Tatara	8	4.88	4.13	4.25	4.38	4.13	3.50	3.88	4.75	4.50	4.38	4.38	**4.29**

Traditional end of course evaluations - Fall 2006

			Item											
		# of Sheets	1	2	3	4	5	6	7	8	9	10	11	**Average**
Ibrahim	Abdel-Motaleb	19	4.63	3.74	3.53	3.58	3.63	4.00	4.32	4.47	4.16	4.37	3.68	**4.01**
Abul	Azad	12	4.91	3.55	3.91	4.09	4.36	3.64	4.55	4.00	4.00	4.36	4.18	**4.14**
Brianno	Coller	59	4.90	4.36	4.16	4.30	3.86	3.36	4.45	4.57	4.53	4.36	4.48	**4.30**
Abhijit	Gupta	32	4.72	3.16	3.06	2.69	2.69	2.50	3.59	4.41	4.47	4.16	3.52	**3.54**
Reinaldo	Moraga	14	4.21	3.29	3.36	3.79	2.64	3.29	4.14	4.21	3.92	4.00	3.38	**3.66**
Regina	Rahn	14	5.00	4.71	4.86	4.71	4.71	3.86	4.50	5.00	5.00	4.43	4.86	**4.69**
Bob	Tatara	19	4.68	3.89	4.21	3.84	3.47	3.63	3.58	4.37	4.47	4.32	3.95	**4.04**

		Fall 2005		Fall 2006	
		# of Sheets	Mean	# of Sheets	Mean
Ibrahim	Abdel-Motaleb	14	3.66	19	4.01
Abul	Azad	11	4.39	12	4.14
Brianno	Coller	54	4.36	59	4.30
Abhijit	Gupta	37	3.77	32	3.54
Reinaldo	Moraga	16	2.59	14	3.66
Regina	Rahn	16	4.57	14	4.69
Bob	Tatara	8	4.29	19	4.04

PROFESSORS -- ***READ OUT LOUD CAREFULLY* to students before handing out questionnaires.**

To: Participating students
Fr: Dean
Re: New initiative to study the quality of instruction, course content, and the learning environment across the college

The following questionnaire is being administered to selected classes across the college and its four departments. As students in those classes, you are being asked to participate in providing baseline information about the quality of instruction, course content, and the learning environment in the college. It is important to take note of the following:

(a) The first part of the questionnaire relates only to this course.

(b) The second part of the questionnaire relates to your experience across all the courses you have taken in your major department.

(c) This questionnaire **does not seek** information about your experience in any courses outside the major department (e.g. general education or courses transferred to NIU).

Your responses to these questions will be used as baseline information to study how to strengthen the quality of education across the college.

We are hoping that you will complete this questionnaire **thoughtfully, seriously, and genuinely,** with the understanding that **it is important** and **will assist us** in structuring a college initiative to study and strengthen the quality of instruction, course content, and the learning environment across the college.

In testing the questionnaire with students, it took about 20 minutes; therefore, we are allowing 30 minutes of class time to complete the questionnaire in class.

The questionnaire is somewhat long, but not as long as it may seem because the questions have been written in a way that hopefully describe thoroughly what we are seeking information about. Also the print is regular sized, and we have spaced and printed the document for easier reading.

Please attend to each item carefully and respond to the best of your ability. We need your input. It is important that you respond honestly, genuinely, and with sincerity as the results of the survey will greatly impact the Dean's new initiative on the quality of education for students in the college.

Thank you for investing your time and serious effort to help us begin this very important initiative.

End of Course Questionnaire on Teaching and Learning
Jule Dee Scarborough (2006)

After completing the student and course information on the front side of the scan form, respond to the following questions on the back side of the form beginning with item 101.

Questions 101-124 focus on the course you are now ending. Please respond to 101-124 based upon your experience in <u>this course only</u>.

101. The course syllabus identified specific learning objectives.
2 a. Yes, and I understood them
1 b. Yes, but I didn't understand them
0 c. I don't know
0 d. No, there were no learning objectives
Max Points Possible = 2.

102. The learning objectives for this course were chosen or required by: (Select all that apply.)
1 a. Future employers
0 b. Department head
0 c. Professor's interests
1 d. Accreditation agency
1 e. NIU General Education Goals
0 f. I don't know
Max Points Possible = 3

103. The course syllabus specified: (Select all that apply)
1 a. course or student learning objectives
1 b. course description
1 c. clearly defined course content
1 d. clearly defined assignments, labs, papers, projects, tests, or other important assignments or activities
1 e. the course schedule or timeline identifying meeting dates, assignment due dates, and the semester's schedule
1 f. additional explanations of course requirements that established the criteria for each assignment
1 g. references other than the text, e.g. books, websites, articles, other sources related to course content
1 h. contact information for professor, instructor, and/or graduate teaching or lab assistants
Max Points Possible = 8

104. The professor (and any assistants): (Select all that apply)

1 a. focused content and learning activities on the course or student learning objectives throughout the semester

1 b. provided learning that seemed to align with the course description

1 c. taught the course content specified in the syllabus

1 d. followed the assignments, labs, papers, projects, tests, or other important assignments or activities outlined and defined in the syllabus

1 e. followed the course schedule or timeline specified in the syllabus (e.g., meeting dates, assignment due dates, and the semester's schedule)

1 f. graded assignments according to the written explanations for course requirements establishing the criteria for each assignment

1 g. was(were) available, using the contact information for professor, instructor, and/or graduate assistants

1 h. deviated from the syllabus by adding <u>appropriate</u> content to expand, deepen understanding, or resolve questions resulting in <u>adding value</u> to the course; any additional assignments were appropriate having reasonable timelines

-1 i. deviated from the syllabus <u>inappropriately</u> where additions to the information provided on the syllabus, or new assignments added, were <u>irrelevant</u> or <u>distracting</u> and added <u>little or no value</u> to the course or learning; new assignments were untimely and caused unnecessary stress for students

1 j. The course was well organized, structured, and executed.

Max Points Possible = 8

105. Which of the following methods were used by the professor to measure learning? (Select all that apply)

1 a. final exam - traditional test

1 b. midterm exam - traditional test

1 c. quizzes and/or short tests periodically-traditional test(s) (e.g., multiple-choice or true/false)

1 d. quizzes and/or short tests periodically - short answer and/or essay

1 e. research or learning paper (s), usually requiring literature search or field research and formal write-up

1 f. case study(ies) in industry, usually requiring a report or short paper write-up

1 g. hands-on technical project(s)

1 h. hands-on non-technical project(s)

1 i. other types of performances, "doing" something

1 j. course portfolio, full documentation of all work and progress in the course

k. other; write a description here:

Max Points Possible = 10

106. <u>Select ALL</u> the descriptions below that identify the methods being used in this course to measure student learning:

1 a. Learning was measured on my ability to memorize terminology, symbols, facts, information, theory, principles, concepts, information, definitions, descriptions

2 b. Learning was measured on my ability to make comparisons to determine similar and dissimilar examples, understanding relationships and connections between and among facts, concepts, theories, principles, translates knowledge into a new context, interpret facts, predict consequences, order, group information, contrast, distinguish, estimate, differentiate, discuss, or extend knowledge

3 c. Learning was measured on my ability to use information, methods, concepts, theories in new situations; problem solving - this requires choosing and applying knowledge (e.g., the best formula, concept, principle, theory to solve problems), using <u>inductive</u> reasoning to determine the best methods, techniques, tools, strategies to apply towards a best solution; this method of measurement can range from a test item with a complex problem to be solved or a hands-on technical problem requiring the design and building of something mechanical. The key to this method is that it requires application of knowledge – "doing" (demonstrate, calculate, illustrate, show, solve, examine, modify, relate, change, experiment, discover).

4 d. Learning was measured on my ability to recognize patterns in information, problems, and situations; the ability to organize parts, identify or discover "hidden" meanings, and/or identify components; this requires one to analyze, separate thoughts, processes, problems, order, explain, connect, classify, and divide, compare, select, explain, and/or make inferences (indirect meanings); this requires <u>deductive</u> reasoning where one begins with facts and information, makes choices to gradually discover the bigger picture

5 e. Learning measured my ability to hypothesize, design, support argument, schematize, write, report, justify, choose, evaluate, estimate, judge, criticize, defend, use old ideas to create new ones, extending the old idea into a new one for extended applications, make choices based upon reasoned argument, verify value of evidence, recognize when subjectivity is being used rather than objectivity (more scientific), make sound generalizations from given facts, relate and use knowledge across different contexts, predict and draw conclusions, combine, integrate, modify, rearrange, substitute knowledge, plan, formulate, compare and discriminate between, summarize, and make conclusions

6 f. Learning measured my ability to design, discover, invent, develop, create, research; transform knowledge into a product, process, technique, model, method, strategy, etc.

Points for only highest level response only. Max Points Possible = 6

107. Select the response that best describes the <u>relationship</u> between the traditional <u>tests</u> you have taken to date in this course (e.g. multiple-choice, true/false items, etc.) and the <u>course content</u> .

3 a. the content of the <u>test</u>(s) **was related** to the content specified in the <u>syllabus,</u> and <u>only to</u> content specified in the syllabus.

2 b. the content of the test(s) **was related** to the content specified in the <u>syllabus</u> **and** <u>other content</u> provided by the professor or assistants.

1 c. the content of the test(s) **did not relate** to the content specified in the <u>syllabus</u> **but did relate** the <u>other content</u> provided by the professor or assistants.

0 d. the content of the test(s) **related to <u>neither</u>** (1) the content specified in the <u>syllabus</u>, **nor** (2) the <u>other content</u> provided by the professor or assistants.

Max Points Possible = 3

Items 108-111 relate to the measurement of student learning through performance(s) <u>rather than</u> traditional tests. * Consider the <u>definitions</u> below when responding to items 108-111.**

***** Definitions:**

*****Performance Task (or assessment) -** *any authentic or real-world task designed to measure student learning. Such a task can be used to determine what students can "do" with knowledge. Unlike some traditional tests, performance tasks require students to move to another level of providing evidence of learning - that of applying or using knowledge by performing authentic tasks, such as designing a part or product, or designing and then producing the part or product. Writing a paper would provide evidence of research skills and communication skills, for example.*

(108) Performance tasks were used to measure student learning in this course. (*see definition above)

1 a. Yes (according to the definition above)
0 b. No (according to the definition above)
Max Points Possible = 1

*****Rubric -** *any type of information sheet or form, check off sheet that establishes the levels of performance criteria for performance tasks; these criteria establish standards for performance and the criteria for each standard. They are used to provide students information about what is required to achieve a particular number of points or grade.* ***See attached example at end of questionnaire following this page; then continue to complete the questionnaire..***

(109) Rubrics were used for scoring or grading the performances in this course.

1 a. Yes (according to the definition below)
0 b. No (according to the definition below)
Max Points Possible = 1

(110) Below are examples of some performance tasks; identify any that are <u>similar</u> to performances that you had to accomplish during this course. Select all that apply:

1 a. Writing a paper
1 b. Working problems, showing the entire equation worked out manually, through each step of the equation
1 c. Designing a product part, entire machine, other major design project
1 d. Designing an industrial production system
1 e. Designing electrical circuitry or full electrical/electronic system
1 f. Designing and producing a part using manufacturing processes, e.g. actually producing product using manufacturing production equipment in a lab or on-site in industry

Max Points Possible = 6

(111) Select all examples of performance tasks below (s<u>imilar</u>) where a rubric or performance criteria <u>form</u> was used to score or grade the performance(s) during this course.

1 a. Writing a paper
1 b. Working problems, showing the entire equation worked out manually, through each step of the equation
1 c. Designing a product part, entire machine, other major design project
1 d. Designing an industrial production system
1 e. Designing electrical circuitry or full electrical/electronic system
1 f. Designing and producing a part using manufacturing processes, e.g. actually producing product using manufacturing production equipment in a lab or on-site in industry

Max Points Possible = 6

112. The following items related to levels of learning and how learning takes place. (Select ALL that apply)

1 a. the learning of basic knowledge requiring me to list, name, identify, show, define, recognize, recall, state, visualize, state facts, concepts, theories, principles, and/or information?

2 b. the comprehension or greater understanding of knowledge through activities that required me to summarize, explain, interpret, describe, compare, paraphrase, differentiate , demonstrate, classify, or contrast facts, information, concepts, theories, principles?

3 c. the application or opportunity to “do” or “perform,” using knowledge, requiring me to solve problems, illustrate, calculate, use, interpret, relate, manipulate, apply, modify facts, concepts, theories, information, or data?

4 d. analytical activities that required me to analyze and organize facts, data, and information; deduce patterns, and trends; contrast, compare, distinguish, differences or similarities; and then discuss solutions, directions and plan or devise actions?

5 e. the synthesis and evaluation of facts, information, data, situations, problems, and furthermore require me to argue rationally, support or justify a method, solution, action, choice of formula, theory, concept, principle or result in the need to propose a hypothesis, following with the design of an experiment, product, process, technique, and/or make judgments that had to be critiqued and defended and finalized into reports, summaries, or papers.

6 f. the design, discovery, invention, development, creation, research, or transformation of knowledge into products, processes, techniques, models, methods, strategies, etc., using design and development, research, experimentation, and/or development knowledge, techniques, procedures, and tools?

Points for highest level only. Max Points Possible = 6

113. This course engaged me in (Select one response)

0 a. learning knowledge and skills to use <u>when</u> I get a job.

1 b. learning knowledge and skills to use when I get a job, <u>but also</u> provided the opportunity <u>to apply</u> that knowledge in class through projects or activities where performing tasks using that knowledge were required

0 c. neither (a) nor (b), very well

Max Points Possible = 1

114. The following list identifies and briefly describes teaching methods the professor may use during instruction. (Select all that apply)

1 a. the professor lectures information and connections; I listen and take notes, if I choose

1 b. the professor focuses or presents content, then breaks the class into student groups to discuss the content, then engages in summarizing and clarifying the content as a group.

1 c. the professor focuses or presents content, then assigns individual but short term projects using the content or information, e.g. problem to solve, design project, analysis.

1 d. the professor focuses or presents content, breaks the class into student groups to discuss the content, and then engages in a short term group project using the content or information (e.g., problems to solve, design project, analysis)

1 e. lessons are broken down in components; as individual students master each component, they are tested. When they pass the test, they go on to the next component.

1 f. the professor uses visual charts, displays, a wide range of graphic organizers or other visuals to better organize and present information; to show relationships between concepts and principles; and to increase understanding about the application of foundation concepts or principles.

1 g. when presenting content, the professor uses examples that are and are not representative of the concept or principle. Students compare the examples and match those that represent the concept or not; gradually as more examples that are and are not representative are reviewed, the group reaches consensus of what examples directly represent the content and come away with greater understanding.

1 h. lessons require that we combine concepts and analyze the relationships of concepts; we then engage in solving problems.

1 i. during the lessons, the professor asks us to identify and enumerate information related to concepts as they are demonstrated, grouping concepts into categories with common attributes.

1 j. we learn information on concepts through the act of classification, gathering and classifying information to build and test hypotheses; they engage in experiments and the results of experiments are used to develop hypothesis generalizations about the situation, idea, or problem.

Max Points Possible = 10

115. The following list identifies and briefly describes <u>additional</u> teaching methods the professor may use during instruction. (Select all that apply)

1 a. students are presented with generalizations and examples and engage in trying to identify the individual situation or idea that is embedded (move from problem to why something happens)

1 b. students are presented with a problem and then create questions to be used to solve the problem. Students engage in a process of investigation and explanation of the phenomena.

1 c. students engage in a formally organized court case to present information and arguments about the ingrained issues.

1 d. students are instructed on each component of the content, and all must be successful on that content before the professor moves on with new or more complex content

1 e. lessons break skills down into components and sequences of action; each person learns the skill step by step the same way

1 f. lessons begin by focusing on a current situation; analogies are used to define the characteristics of the situation; analogies continue, using other graduated analogies until it appears to have no relationship to the origin; the lesson then uses the final description of the analogy to compare to the original situation

1 g. lessons engage us in the development of physical skills, such as welding

1 h. the professor uses metaphors to make content more familiar

1 i. lessons focus on personal development, free expression of ideas and feelings, furthering your self-understanding

1 j. students explore problems through actions developing problem solving skills; we participate and/or observe

Max Points Possible = 10

116. My professor exhibited the following styles of instruction throughout the semester. (Select all that apply.)

1	a.	professor makes all decisions on what, where, when, and how learning takes place; is the expert; strives for precision, synchronization, and uniformity; determines what is taught and how it will be evaluated
1	b.	students are given a number of tasks to do while in class; students can ask questions; professor moves around and gives feedback
1	c.	students provide feedback to each other; one student performs while another provides feedback; professor designs forms to guide the observations; socialization is inherent in this style; students develop feedback skills
1	d.	feedback is provided by you as the individual learner to yourself; other events providing external feedback facilitate your ability to do this; professor helps you become a better evaluator, thus, increasing your self-esteem about working independently
1	e.	we select our own level of performance and alter it according to my/our self-evaluation; the professor determined the tasks and defined the levels of difficulty
1	f.	professor leads students to discover concept by answering a series of questions; professor determines concepts and best sequences for guidance; friendly environment with time to think built into the learning opportunity; professor traces a series of questions leading to the answer
1	g.	professor presents question; students use logical and critical thinking to discover solutions; students determine questions to ask rather than the professor; professor respects the student process and dos not interfere
1	h.	professor encourages students to find multiple solutions to given problems; professor selects the subject and designs the problem; there is no one right answer; professor responds to student process rather than the value of a solution or answer
1	i.	the student and professor select the content to be learned; the student designs, develops, and performs the series of tasks **and/or** students select the activity, design the experiences, perform the tasks; professors assists/consults with the evaluation of tasks
1	j.	students are empowered to take full responsibility for the learning process; they are not required to consult with the professor

Max Points Possible = 10

117. Which of the following best describes this course?
Choose the one item that comes closest to describing your experience in this course.

0 a. The professor assumes the entire responsibility for delivering the course content. He/she lectures all information we are expected to learn. The text is used as a reference. Lectures reflect text content.

0 b. The professor assumes the entire responsibility for delivering the course content in combination with assigned readings from the textbook. The lectures and text content provide all the information we are expected to learn. Most lectures correlate directly or are duplication of text content.

0 c. Students are assigned reading from the text to gain basic course content. My professor explains difficult content from the text and then adds lectures on some important or critical content that is not covered in the text, thus expanding or deepening understanding and ability to use the information from the text.

1 d. Students are responsible for some of their own learning. For example, once a concept or principle is explained by the professor and we have used the text for basic learning, as a source or reference, we then have to perform research on content ourselves to deepen our understanding of the concept and its application possibilities. We have to bring the information back to class to share with the professor and class. Student activities can vary from literature research, case studies, identifying additional sources of information, e.g. books, people, examples, demonstrations, etc. Students are required to learn on their own or in small groups to deepen understanding or extend learning and understanding beyond that presented by the professor or established learning activities.

2 e. The professor assigns reading from the text, explains difficult content, and then provides content to deepen or extend the basic text content or to clarify or explain content not well understood. Students are responsible for some of their own learning, and we then engage in research to solidify our understanding of the content. Ultimately, the professor then assigns projects that expand learning into the "doing" dimension where we used the content learned to solve a problem, develop a product, construct a theoretical model, use materials, processes, and knowledge to create, etc.

3 f. Students are responsible for a great deal of their own learning. After working with us in a variety of ways, many of them are highly engaging students to learn important knowledge and skills where the professor is more of a learning coach, direction setter, source of validation, someone who models an inquiry driven process of learning, with a strong focus on "how" and "why" processes. He/she provides the opportunity to engage in the creation of a solution to an identified need or problem, applying the knowledge and skills learned earlier or throughout the learning processes throughout the semester.

Max Points Possible = 3

118. This course provided the opportunity to work cooperatively in small groups to accomplish the learning of course content. (Select one)

1 a. Yes
0 b. No
Max Points Possible = 1

119. When working together, we sought outcomes that benefited me individually as well as the whole group. (Select one)

2 a. Most of the time
1 b. Some of the time
0 c. Not really
0 c. No opportunity to work in groups
Max Points Possible = 2

120. When working with others, I feel that we maximized my own learning and the learning of others. (Select one)

2 a. Most of the time
1 b. Some of the time
0 c. Not really
0 d. No opportunity to work in groups
Max Points Possible = 2

121. Working in groups provided greater opportunity for everyone to learn more and resulted in higher grades for all. (Select one)

2 a. Most of the time
1 b. Some of the time
0 c. Not really
0 d. No opportunity to work in groups
Max Points Possible = 2

122. When you were required to work in student groups throughout the course, were those group assignments formally organized with criteria for performance? (Select one)

2 a. Most of the time
1 b. Some of the time
0 c. Not really
0 d. No opportunity to work in groups
Max Points Possible = 2

123. When you were required to work in student groups throughout the course, did the professor provide formal and specific team related instruction on how to function effectively and productively on a team? (Select one)

1 a. Yes
0 b. No
Max Points Possible = 1

124. Working in groups results in:
(Select as many as apply b-i; if you choose response a, move on to question 125)

0 a. there was no opportunity to work in groups
(**if you choose this selection, move on to question 125**)

1 b. higher achievement and productivity by all or almost all members of the group

1 c. longer term retention of knowledge being learned

1 d. intrinsic (inside myself) and higher motivation to achieve by all or almost all members of the group; greater focus and time on task

1 e. higher level thinking, reasoning, deeper analysis of problems, better judgments

1 f. more positive relationships between most students or among group members and more caring about each other's learning and success; feelings of more support in learning

1 g. greater value of diversity among group members; greater cohesion among students in the course

1 h. the development of higher self-esteem among most students; further development of self identify

1 i. development of social skills so that students learn to engage with each other in a positive manner, even when conflicting ideas are on the table

1 j. greater ability to cope with adversity and stress
Max Points Possible = 9

125. The professor's language skills <u>were not</u> a barrier in communication between the professor and students.

4 a. <u>Strongly agree</u> - the professor's language skills were <u>exceptionally good</u>; very effective communication took place between the professor and students.

3 b. <u>Agree</u> - the professor's language skills were <u>good</u>; there was effective communication between the professor and students.

1 c. <u>Disagree</u> - the professor's language skills <u>need to improve</u> for effective communication to occur between the professor and students.

0 d. <u>Strongly Disagree</u> - the professor's language skills were <u>inadequate</u> for effective communication between the professor and students; poor language skills resulted in communication barrier between the professor and students.
Max Points Possible = 4

Unlike Items 101-125 above which focused on THE course you are NOW in and completing, <u>the following questions are focused more broadly</u>.

<u>For Items 126-136, reflect on your experience across ALL the courses</u> you have taken in engineering and/or technology to date. Provide your perspective by <u>generalizing across ALL the courses</u> that you have taken in engineering and/or technology to date and respond to Items 125-135 below.

126. The <u>professors</u> teaching the engineering and/or technology courses that I've taken to date in my major: (Select one)

3 a. seem exceptionally competent and knowledgeable
2 b. seem competent and knowledgeable
1 c. seem adequate in their knowledge
0 d. professor's knowledge seems questionable
Max Points Possible = 3

127. The professors <u>teaching</u> the courses that I've taken in engineering and/or technology teach in a way that: (Select one)

2 a. motivates me to want to learn and perform in those classes at a very high level; they keep me interested, excited, and make me realize that I have chosen the right field or career track for me
1 b. keeps me interested most of the time so that I perform above average most of the time
0 c. is difficult for me to maintain my interest in the courses; it is often difficult to remain interested all the way through each class; I feel I can read the book and take the tests and still perform well enough for an adequate grade
0 d. truly causes me to be less motivated to perform, making it almost impossible to remain interested in the courses or content being covered
Max Points Possible = 2

128. The <u>learning environment</u> in the college and department <u>is positive</u> in the following ways: (Select all that apply)

1 a. the learning environment and climate are positive
1 b. there is appropriate technology, computer labs, specialized technology related to each discipline
1 c. there are good labs, lab equipment,
1 d. there is adequate student work space for assignments, projects, group meetings, etc.
1 e. administrators are approachable and helpful (e.g., the department chairs (heads) and dean)
1 f. faculty are available, approachable, professional, and helpful
1 g. department and college staff are available, professional, and helpful in solving problems or meeting student needs, and friendly
1 h. faculty take extra time, or go the extra mile, and are available to support and assist students in solving problems or meeting their needs
1 i the academic advising I have received is of high quality and accurate
1 j. graduate teaching or lab assistants seem to be knowledgeable and competent
Max Points Possible = 10

129. The <u>learning environment</u> in the college and department <u>needs to improve</u> the following:
(Select all that apply)

-1 a. the learning environment and climate
-1 b. technology, computer labs, specialized technology related to each discipline
-1 c. labs and lab equipment,
-1 d. student work space for assignments, projects, group meetings, etc.
-1 e. administrators approachability and willingness to be helpful (e.g., the department chairs (heads) and dean)
-1 f. faculty availability, approachability, professionalism, and willingness to be helpful
-1 g. department and college staff are availability, professionalism, and helpfulness in solving problems or meeting student needs, and friendliness
-1 h. faculty willingness to take extra time, or go the extra mile, and be available to support and assist
students in solving problems or meeting their needs
-1 i academic advising
-1 j. knowledge and competence of graduate teaching or lab assistants
Max Points Possible = 0

130. Generally, when considering <u>course quality</u>, the courses I've taken so far seem to have had well planned content, sound academic purpose, appropriate and well designed lab activities, and excellent execution of student learning activities by the professor and/or grad assistant.
(Select one)

3 a. strongly agree
2 b. most or many do
1 c. some (less than half) do
0 d. most or many do not
Max Points Possible = 3

131. The courses that I've taken so far seem to have been well-structured and organized with clear learning objectives that are focused, purposeful; the courses have had well designed and developed syllabi that clearly explain the expectations of the professor for the course and a schedule or timeline provides an understanding of the events, due dates, and activities for the semester.
(Select one)

3 a. strongly agree
2 b. most or many do
1 c. some (less than half) do
0 d. most or many do not
Max Points Possible = 3

For Items 132-136, consider the <u>connections</u> between course <u>syllabi, assignments, and schedule</u> for all the courses you taken to date; when generalizing across ALL the courses you have taken in engineering or technology, <u>most</u> of your professors: (Select one response for each 132-134)

132. covered the course content specified in the syllabus, expanding when appropriate

1 a. yes
0 b. no
Max Points Possible = 1

133. adhered to the assignments specified in the syllabus and didn't add anything significant

1 a. yes
0 b. no
Max Points Possible =1

134. progressed through the course according to the schedule plan in the syllabus

1 a. yes
0 b. no
Max Points Possible = 1

135. In most of my courses, the <u>tests</u> (or other methods of measuring student learning such as projects, etc., papers, research, etc.) are <u>directly linked</u> and <u>connected to the content described in the syllabus.</u> (Select one)

2 a. Yes, most of the time
1 b. Usually, but there are some major deviations from the syllabi across courses
0 c. Less than half of the time; there is a lot of content on tests, or content that we are required to know and use for projects, etc. that was not specified on course syllabi
-1 d. There has often been a "dis-connect" between the knowledge and/or skills that we were tested on or required to use on projects, etc. and what was specified on course syllabi across the courses I have taken
Max Points Possible = 2

136. In most of my courses, the <u>tests</u> (or other methods of measuring student learning such as projects, etc., papers, research, etc.) are <u>directly linked</u> and <u>connected to the content covered by the professors.</u> (Select one)

2 a. Yes, most of the time
1 b. Usually, but there have been some major deviations by the professors across courses
0 c. Less than half of the time; there is a lot of content on tests or content that we were required to know and use for projects, etc. that was <u>not</u> specified on course syllabi or <u>covered by the</u> <u>professors</u> or assistants.
-1 d. There has often been a <u>"dis-connect"</u> between the knowledge and/or skills that we were tested on or required to use on projects, etc. and what was covered by the professors or assistants. A lot of course content <u>was not</u> covered by the professors or assistants.
Max Points Possible = 2

INTRODUCTION TO COURSE ANALYSIS

(See Program Description in Portfolio Section A.5, Course Analysis Data, Reports, and Professor Examples in B.5.a, 1, 2, 3 and B.5.b, 1, 2, 3; also, Worksheets in C.1)

Jule Dee Scarborough, Ph.D.

Professors each chose one course for the faculty development program on teaching and learning. The selected course (taught Fall 2005) was the vehicle for learning. Analyzing a real course, instructional practices, student assessments, and other aspects of teaching and learning ensured an authentic problem based learning scenario and process. The 2005 course was changed according to the analyses results and as the learning process progressed through each of the program components. The course was then re-developed during particular program components, once again ensuring authentic and problem-based learning through performance tasks. The re-developed course was taught during the Fall 2006 research semester as the context for implementing the changes and the experimental research on teaching and learning by each professor. Therefore, professors taught a completely re-developed course and engaged in the Scholarship of Teaching through classroom research Fall 2006.

The faculty development program engaged professors in an intense analysis of their existing 2005 courses. For example, they analyzed the quality of the course content using the ABET/TAC/NAIT outcomes; they considered how the courses were taught, the quality of their teaching strategies, and if students had opportunities to use or expand their individual learning styles. The professors analyzed their tests and expanded the student assessment tools for the course by developing performance tasks and rubrics. They considered their grading strategies and philosophies, the quality of their syllabus and what it communicated, and much more.

The learning process was led by the program leader; however, it was also led by the professors themselves in that they used self-assessment through a portfolio assessment process. This provided them the opportunity to critically reflect on and analyze the "current reality" of the 2005 courses and then determine what needed changing regarding the course, teaching, or assessment aspects. The program process involved presentations, group process using the jigsawing of information, a myriad of worksheets with corresponding reference information in written form, group review, sharing, and critique, and finally redevelopment. The process was inquiry based and guided discovery in action, which resulted in a performing-while-learning process. As the professors analyzed their courses for a variety of teaching and learning factors, they were also learning about teaching and learning. Performing the analyses was performance-based learning, resulting in educational products, and the learning process itself.

Each professor performed the analyses listed below on the selected 2005 courses:

1. Knowledge Content (content breakout outline; content priorities; content timeline)
2. Content Sources
3. Embedded NIU General Education Goals
4. Content Schedule
5. Teaching Models
6. Teaching Styles
7. Student Learning Styles
8. Bloom's Cognitive Process Dimension (Traditional or Revised)
9. Bloom's Knowledge Dimension
10. Dale's Cone of Learning
11. Level of Critical Thinking
12. Teacher, Knowledge, Assessment, or Learner-Centered?
13. Instructional Design Gaps
14. Student Learning Outcomes by
    a. Bloom
    b. Dale
    c. Knowledge Sources
    d. Assessments (Tests) by
        i. Bloom
        ii. Dale
    e. Test Items by
        i. Bloom
        ii. Dale
    f. Other assessments, projects, etc. by
        i. Bloom
        ii. Dale
15. GAPS Analysis Summary
    a. Outcomes Summary
    b. General Education Summary
    c. Outcomes by Teaching Models Summary
    d. Outcomes by Teaching Styles Summary
    e. Outcomes by Student Learning Style Opportunity Summary
    f. Outcomes by Bloom's Cognitive Process Dimension
    g. Outcomes by Bloom's Knowledge Dimension
    h. Outcomes by Dale's Cone of Learning Levels
    i. Outcomes by Critical Thinking Levels
16. Test Analyses
    a. Item quality
        i. item discrimination
        ii. item difficulty
        iii. other

(See each data table for the outcomes of this process in Portfolio Sections B.0-B13 and worksheet forms in Section C)

The professors studied the results of the 2005 analyses, made decisions about what changes would benefit student learning, and engaged in redeveloping the courses for the 2006 research semester. Course re-development involved them in

1. Student Learning Outcome development by ABET/TAC/NAIT standards or outcomes
2. Identification of embedded NIU's General Education Goals
3. Determination of Bloom's Knowledge Dimension for each student learning outcome
4. Bloom's Cognitive Process Dimension for each student learning outcome
5. Development of a course calendar identifying for each week/course day:
    a. Teaching Models
    b. Teaching Styles
    c. Student Learning Style opportunities
    d. Dale's Cone of Learning Levels
    e. Course Content Topics
    f. Course Labs or Activities
    g. Course Due Dates
6. Test Development
    a. Table of Specifications
    b. Item Bank
    c. Test Assembly
    d. Charting student learning outcomes by tests and test items
7. Performance Assessments
    a. Performance Tasks
    b. Corresponding Rubrics
8. Multifaceted Assessment Plan
    a. Identification of other types of student assessments
    c. Charting assessments by Bloom's Cognitive Process Dimensions
    d. Charting student assessments
6. Teaching Models and Instructional Design for Course Context
    a. Choosing additional teaching models
    b. Designing instruction for entire course

(See Data Tables and Teaching Portfolios for these products B.0-B.13.)

The professors tested the effectiveness of their redeveloped course, teaching and learning strategies, and new student assessments during the research semester, Fall 2006. They also engaged in experimental research on a particular teaching and learning question.

After teaching the re-developed courses, the professors engaged in reflection about their teaching practices and student learning during the 2006 semester. They confirmed, or identified where they did or did not achieve, the planned

1. Teaching Models and Teaching Styles
2. Student Learning Style opportunities
3. Student Learning Outcomes
4. Bloom's Cognitive Process Dimensions
5. Dale's Cone of Learning Levels

In addition, they engaged in critical reflection on the student assessment plan and analyzed the effectiveness of the new tests and performance assessments:

1. Midterm exam test analysis and diagnostic write up
2. Final exam test analysis and diagnostic write up
3. Performance assessment/rubric reflection and diagnostic write up

(See Portfolio Section B6)

Important Note: In the Course Analysis Data Sections, most of the worksheets provide summaries of data across professors. However, several worksheets are not shown with data, as the GAPS Analysis Summary provides that same information. The analysis information professors generated during those processes was then summarized in the GAPS Analysis Summary. The information in those two analyses was so specific to each professor, it would be impossible to present a coherent composite for 1) Content Schedule, Models, Styles, Bloom's, etc. and 2) Instructional Design GAPs. Thus, that same information was summarized by the professors in the overall GAPS Analysis Summary composite. All other worksheets are presented as complete composites.

Discipline Course Outline – IENG 475 – Decision Analysis: Regina Rahn

Course Disciplinary Content

I. Linear Value Functions and Decision Making Under Uncertainty
- A. Introduction
- B. Decision Trees
  - 1. Structure
  - 2. Outcomes
- C. Expected Monetary Value
- D. Value of Perfect and Imperfect Information
- E. Bayes Theorem
  - 1. Overview of Probability
  - 2. Joint, Conditional, and Marginal Probabilities
- F. Conditional Likelihood Ratios
- G. Sensitivity Analysis

II. Utility Theory – Single Attribute Case
- A. Motivation
- B. Axioms
- C. Degree of Risk Aversion
- D. Lotteries
  - 1. Risk Premium
  - 2. Buying Price
  - 3. Selling Price
  - 4. Certainty Equivalent
  - 5. Insurance Premium
- E. Utility Functions

III. Fault Tree Analysis
- A. Event Description
- B. Construction Methodology
- C. Evaluation
  - 1. Reliability and Failure Probability Relationships
  - 2. Propagation Through the Gates
  - 3. Qualitative Evaluation
  - 4. Quantitative Evaluation
- D. Equivalent Fault Trees
- E. Dual Fault Trees

IV. Utility Theory – Multi-Attribute Case
- A. The General Case
- B. Additive Functions

Science(s) Foundation Required
(Id. Physics, Chemistry, Biology, etc.)

None

Mathematics Foundation Required

A. Algebra
B. Calculus
C. Probability and Statistics

Communication Foundation/ Skills Required

A. Writing
B. Speaking

Table B.5.a.1.1: **Content Schedule and Styles, Models, Bloom's Analysis – IENG 475 Decision Analysis: Regina Rahn**

Week	**Content Topic:** *Factual, Conceptual, Procedural, Meta-cognitive*	**Content Source** *Text, etc.*	**Teaching Style** *a-k; fpfd*	**Learning Style** *CE, AE, AC, RO*	**Teaching Model** *1-24 name*	**Dale's Cone** *Active or Passive*	**Bloom's Traditional:** *Evaluation, Synthesis, Analysis, Application, Comprehension, Knowledge*	**Bloom's Revised** *Create, Evaluate, Analyze, Apply, Understand, Remember*	**Critical Thinking** (1-5, 1 is low)	**Centered?** *Teacher, Knowledge Assessment, Learner*
1	Introduction – f,c	LN, text ch. 1,2	A	AR	4	HIGH PASSIVE	K	R	1	
	Decision tree structure & outcomes – f,c,p	LN, text ch. 3,4	A	AR	4	HIGH PASSIVE	K	R	2	
2	Probability Overview – f,p	LN, HO	A	AA,AR	4	HIGH PASSIVE	K	R	1	
	Expected Value (EMV) – f,c,p	LN, text ch. 4	A	AA,AR	4	HIGH PASSIVE	K	R	2	
3	EVPI & EVSI – f,p	LN, CH. 12, paper	A	AR	4	HIGH PASSIVE	K	R	2	
	Baye's Theorem – f,p,c	LN	A	AA,AR	4,14	HIGH PASSIVE	K	R	2	
4	Intro to Sensitivity Analysis – f,c,p,m	LN, text ch. 5	A	AA,AR	4,14	HIGH PASSIVE	K	R	2	
	Case Study – p,c,m	LN, HO	B	CR,AR,AA	12	ACTIVE	K,C,AP,AN	R,U,AP,AN	4	
5	Continue Case Study – c,p,m	LN, HO	B	CR,AR,AA	7,12,13,14	ACTIVE	K,C,AP,AN	R,U,AP,AN	4	
	Conditional Likelihood Ratios – f,c,p	LN	A	AA,AR	4,14	HIGH PASSIVE	K	R	2	
6	Intro to Utility Theory – f,c	LN	A	AR	4	HIGH PASSIVE	K	R	1	
	Motivation and Axioms – f,c,m	LN, text ch. 13,14	A	AR	4	HIGH PASSIVE	K	R	2	
7	Degrees of Risk – f,c,p	LN, text ch. 13,14	A	AR	4	HIGH PASSIVE	K	R	2	
	Lotteries – f,c,p	Ln	A	AA,AR	4	HIGH PASSIVE	K	R	2	
8	Lotteries, Calculations & Examples – c,p,m	LN	A	AA,AR	4,12	LOW ACTIVE	K,C,AP	R,U,AP	3	
	Two Lotteries at a Time – c,p,m	LN	A	AR	4	HIGH PASSIVE	K	R	1	
9	Single Attribute Utility Functions – c,p	LN, text ch. 13	A	AA,AR	4,12,14	ACTIVE	K,C,AP,AN	R,U,AP,AN	4	
	Review Session – c,p,m	Notes	B	CA,CR,AA	12,13	ACTIVE	K,C,AP	R,U,AP	3	
10	Mid-Term Exam – c,p,m	Exam	B	CA,CR,AA AR	12,13,14	ACTIVE	K,C,AP,AN	R,U,AP,AN	3	
	Project Discussion – c,m	Projects	C	CA,CR,AA	5,14,15	ACTIVE	K,C,AP,AN,S,E	R,U,AP,AN,E	5	
11	Intro to Fault Trees – f,c	LN, HO	A	AR	4	HIGH PASSIVE	K	R	1	
	Discuss Mid-Term – c,p,m	Go over exam	B	AA,CR	4,12	LOW ACTIVE	K,C,AP,AN	R,U,AP,AN	4	

12	Evaluation of Fault Trees (Qualitative)– c,p,m	LN, HO	A	AR	4	HIGH PASSIVE	K	R	2	
	Evaluation of Fault Trees (Quantitative)– c,p,m	LN, HO	A	AR	4	HIGH PASSIVE	K	R	2	
13	Fault Tree Case Study – c,p,m	LN, HO	B	CR,AA,AR	4,12,14	ACTIVE	K,C,AP,AN	R,U,AP,AN	4	
	Equivalent & Dual Fault Trees – f,c,p	LN, HO	A	AR	4	HIGH PASSIVE	K	R	2	
14	Multi-Attribute Utility Theory (MAU)– c,p	LN, paper, text ch. 15,16	A	AR	4	HIGH PASSIVE	K	R	2	
	MAU Calculations and Examples –c,p,m	LN	B	CR,AR,AA	4,12,14	LOW ACTIVE	K,C	K,C	3	
15	Review of Course –c,p,m	Review discussion	A,B	CR,AR,AA	4,12,13	LOW ACTIVE	K,C,AP,AN	K,C,AP,AN	4	
	Project Presentations – c,p,m	Projects	B,C	CA	5	ACTIVE	K,C,AP,AN,S,E	R,U,AP,AN,E	5	
16	Final Exam – c,p,m	Final exam	B	CA,CR,AR, AA	12,13,14	ACTIVE	K,C,AP,AN	R,U,AP,AN	4	

Note: There is a practice by some professors to give the final exam before or during the **last week of CLASS**, rather than the **FINAL EXAM WEEK**. This essentially means that you are "cheating" the students out of one day of content, learning, etc. We should have 15 weeks of learning, including exam, quizzes, or project days, but to make the **final week of class** the **FINAL exam week** is unethical by NIU standards, regardless of who does it. **What is your practice?** We always meet on the day of the final.

Table B.5.a.1.2: Instructional Design Gaps Analysis Table – IENG 475 Decision Analysis: Regina Rahn

ABET/ NAIT Standard a-k Eng A-Q Tech	**NIU General Ed Goals (embedded)** a-I, ii, iii, iv b-I, ii, iii, iv c and d	**Student Learning Objectives listed on syllabus**	**Bloom/Dale** *Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive*	**Knowledge Sources** Professor, Text, Cases, Speaker, References, etc.	**Student Assessments listed on syllabus**	**Bloom/Dale** *Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive*	**Test Items or Projects/Rubrics**	**Bloom/Dale** *Evaluation Synthesis Analysis Application Comprehension Knowledge*	**Performance** *IF any; if none, leave blank*	**Bloom/Dale** *Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive*
a,d,(h)		To study the meaning and application of analytic decision making techniques for technical decision making under uncertainty.	Application, active	See content schedule	HW, Mid-term, Final	Application active	HW1 HW2 #3.25, 4.14 HW3 #13.24 Midterm #II Final #1,4,5,6	Application Application Application Application Application		
a,d, (k)		To learn a specific set of analytical tools. These tools are applicable to technical decisions that must be made when present or future states of nature are uncertain, and multiple attributes are considered. Included in these methods are decision tree methodology and utility theory.	Application		HW, Mid-term, Final, project	Analysis, some synthesis active	HW1 HW2 #3.25, 4.14, 5.9, 5.12 HW3 #13.27,28 HW5 #1,2 Midterm #I Final #3	Analysis, Syn Analysis Synthesis Analysis Analysis Analysis, Syn Synthesis		
a,d, (b,k,i,j,f)		To become aware of the limitations of the models for rational decision making.	Evaluation, active		Project	Some evaluation active	Project	Evaluation	Presentation and discussion of projects	
a,d,c, (f,g,m)		To allow students to practice the structuring and solution of complicated decision problems.	Evaluation, active		HW, Mid-term, final, project	Application, analysis, some evaluation active	HW1 Midterm #I Final # 2,3,6 Project	Anal, Syn Anal, Syn Anal, Syn Evaluation		

Table B.5.a.2.1: **Discipline Course Outline (IENG370 – Reinaldo Moraga)**

Course Disciplinary Content	**Science(s) Foundation Required**	**Mathematics Foundation Required**	**Communication Foundation/ Skills Required**
I. Overview			
II. Linear Programming (LP) A. LP Assumptions B. Model Formulations 1. Graphical Method 2. Classical and Large Formulations C. Simplex Method 1. Standard LP Model and Transformations 2. Tabular Form and Algorithm 3. Two Phase Method	Not directly apply	A. Linear Algebra 1. Systems of Equations 2. Operations with Matrices	Quantitative Reasoning Use of Technology (Software) Communicate in Writing Interrelatedness of disciplines
III. Duality Theory and Sensitivity Analysis (DSA) A. Economic Interpretation of duality B. Primal-Dual Relationships C. Dual-Simplex Method D. Sensitivity Analysis E. Use of Software LINDO	Not directly apply	Same	Same
IV. Transportation and Assignment Problems (TAP) A. The Transportation Problem B. The Assignment Problem C. The Transshipment Problem	Not directly apply	Same	Same
V. Network Optimization Models (NOP) A. Terminology of Networks B. The Shortest-Path Problem C. The Minimum Spanning Tree Problem D. The Maximum Flow Problem E. The Minimum Cost Flow Problem	Not directly apply	Same	Same
VI. Integer Programming (IP) A. Assumptions B. Formulations C. Branch and Bound Algorithm	Not directly apply	Same	Same
VII. Dynamic Programming (DP) A. Characteristics of Dynamic Programming B. Deterministic Dynamic Programming	Not directly apply	Same	Same

Table B.5.a.2.2: **Content Schedule and Styles, Models, Bloom's Analysis**

Week	**Content Topic:** *Factual, Conceptual, Procedural, Meta-cognitive*	**Content Source** *Text, etc.*	**Teaching Style** *a-k; fpfd*	**Learning Style** *CE, AE, AC, RO*	**Teaching Model** *1-24 name*	**Dale's Cone** *Active or Passive*	**Bloom's Traditional:** *Evaluation, Synthesis, Analysis, Application, Comprehension , Knowledge*	**Bloom's Revised** *Create, Evaluate, Analyze, Apply, Understand, Remember*	**Critical Thinking**	**Centered?** *Teacher, Knowledge Assessment, Learner*
1	Syllabus, Blackboard									
	Overview	Inst.	a,b				Knowledge, Comprehension	Understand, Apply	2	
2	LP – Assumptions	Ch1	a,b	AE, AC	4Lecture, 7CoopLrning14Deductive	Passive	Knowledge, Comprehension	Understand, Apply	2	
	LP – Models	Ch2&3	a,b	AE, AC	same	Passive/Active	Knowledge, Comprehension, Application	Understand, Apply	2	
3	Holliday						Knowledge, Comprehension, Application	Understand, Apply		
	LP – Models	Ch3	a,b	AE, AC	same	Passive/Active	Knowledge, Comprehension, Application	Understand, Apply	2	
4	LP – Simplex Method	Ch4	a,b	AE, AC	same	Passive	Knowledge, Comprehension, Application	Understand, Apply	3	
	LP – Simplex Method	Ch4	a,b	AE, AC	same	Passive	Knowledge, Comprehension, Application	Understand, Apply	3	
5	LP – Simplex Method	Ch4	a,b	AE, AC	same	Passive/Active	Knowledge, Comprehension, Application	Understand, Apply	4	
	LP – Simplex Method	Ch4	a,b	AE, AC	same	Passive/Active	Knowledge, Comprehension, Application	Understand, Apply	4	
6	DSA – EI, P/D Relationship	Ch6	a,b	AE, AC	same	Passive	Analysis	Understand, Apply, Analyze	4	
	DSA – D/S Method	Ch6	a,b	AE, AC	same	Passive	Analysis	Understand, Apply, Analyze	4	
7	DSA – S. Analysis	Ch6	a,b	AE, AC	same	Passive/Active	Analysis	Understand, Apply, Analyze	4	
	DSA – Software		a,b	AE, AC	same	Passive/Active	Knowledge, Comprehension	Apply	4	
8	In-class Exam									
	Mini-case in class		a,b	AE, AC	same	Active	Comprehension, Application, Evaluation	Analyze, Evaluate	5	
9	TAP – Transportation	Ch8	a,b	AE, AC	same	Passive	Application, Evaluation	Understand, Apply, Analyze	4	
	TAP – Transportation	Ch8	a,b	AE, AC	same	Passive	Application, Evaluation	Understand, Apply, Analyze	4	
10	TAP – Assignment	Ch8	a,b	AE, AC	same	Passive	Application, Evaluation	Understand, Apply, Analyze	4	
	TAP – Transshipment	Ch8	a,b	AE, AC	same	Passive	Application, Evaluation	Understand, Apply, Analyze	4	
11	NOP – Terminology, SP problem	Ch9	a,b	AE, AC	same	Passive	Application, Evaluation	Understand, Apply, Analyze	4	
	NOP – STP, MFP	Ch9	a,b	AE, AC	same	Passive	Application, Evaluation	Understand, Apply, Analyze	4	
12	NOP – MCFP	Ch9	a,b	AE, AC	same	Passive	Application, Evaluation	Understand, Apply, Analyze	4	

	IP – Assmptn, Formulations	Ch11	a,b	AE, AC	same	Passive/Active	Knowledge, Comprehension, Application	Understand, Apply	3	
13	IP – BB algorithms	Ch11	a,b	AE, AC	same	Passive	Knowledge, Comprehension, Application	Understand, Apply	3	
	DP – Characteristics	Ch10	a,b	AE, AC	same	Passive	Knowledge, Comprehension, Application	Understand, Apply	3	
14	DP – Example	Ch10	a,b	AE, AC	same	Passive	Knowledge, Comprehension, Application	Understand, Apply	3	
	Holliday									
15	Project Presentations		c,d				Synthesis, Evaluation	Analyze, Create	5	
	Project Presentations		c,d				Synthesis, Evaluation	Analyze, Create	5	
16	Take-Home Final Exam Due									

Note: There is a practice by some professors to give the final exam before or during the **last week of CLASS**, rather than the **FINAL EXAM WEEK**. This essentially means that you are "cheating" the students out of one day of content, learning, etc. We should have 15 weeks of learning, including exam, quizzes, or project days, but to make the **final week of class** the **FINAL exam week** is unethical by NIU standards, regardless of who does it. **What is your practice?**

Table B.5.a.2.3: **Instructional Design Gaps Analysis Table**

ABET/ NAIT Standard **a-k Eng** **A-Q Tech**	**NIU General Ed Goals** **(embedded)** **a-I, ii, iii, iv** **b-I, ii, iii, iv** **c and d**	**Student Learning Objectives listed on syllabus**	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***	**Knowledge Sources** **Professor, Text, Cases, Speaker, References, etc.**	**Student Assessments listed on syllabus**	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***	**Test Items or Projects/Rubrics**	**Bloom/Dale** ***Evaluation Synthesis Analysis Application Comprehension Knowledge***	**Performance** ***IF any; if none, leave blank***	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***
3-4 a,e,k 1-2 b,c,d	a-ii, iii c	1. To provide students with a working knowledge of fundamental methods and applications of deterministic operations research models.	Evaluation Synthesis Analysis Application Comprehension Knowledge	Text, Cases	6 Quizzes (15%), Hwork 1,2,3 + Case study (15%)	Synthesis, Analysis, Application Comprehension	<u>Problem solving</u> Quiz 1. Formulation Quiz 2. Simplex Method Quiz 3. Sensitivity Analysis Quiz 4. Transportation Quiz 5. Transportation Quiz 6. Networks Exercises from Chapters Hmw1. 2.2-2, 2.3-1 Hmw2. 3.1-9, 3.4-14 Hmw3. 4.1-8, 4.3-4, 4.7-4. Case study 4.1	Synthesis/Active Application/Active Analysis/Active Application/Active Application/Active Application/Active Comprehen/Pasive Synthesis/Active Application/Active Evaluation/Active		
3-4 a,e,k 1-2 b,c,d	a-ii, iii c	2. By the end of the semester, students should be able to determine when each of the various models we have covered is appropriate, to formulate a valid model, to interpret the results of the model that is formulated, and to apply them to practical engineering situations or problems.	Evaluation Synthesis Analysis Application Comprehension Knowledge	Text, Cases	Group projects (20%). Define a real-world situation and solve it applying tools seen in class. Individual evaluations submitted by all group members Midterm exam (20%), Comprehensive take-home final exam	Evaluation Synthesis Synthesis Application Comprehension Application Comprehension	Midterm (1^{st} half): In class (.3): P1. Formulation 3.4-12 P2. Solving Simplex Method P3. 14 Multiple choice questions TkHm (.7): P1. Formulation P2. Solving Simplex Method Final Exam: P1 9.3-6	Synthesis/Active Application/Active Comprehension/Passive Synthesis/Active Application/Active Application/Active		

					(30%).		P2 9.4-2 P3 8.3-2 a,b P4 8.2-8 a,b P5 6.6-3 a,b,c P6 Project in a real situation.	Application/Active Application/Active Application/Active Application/Active Comprehension/Passive Evaluation/Active		
					An **optional** term paper to help those interested in getting a better grade.	Synthesis				

Table B.5.a.3.1: Discipline Course Outline

Course Disciplinary Content	**Science(s) Foundation Required** (Id. Physics, Chemistry, Biology, etc.)	**Mathematics Foundation Required**	**Communication Foundation/ Skills Required**
I. Unit			
A. Review of Dynamics	A. Physics, Chemistry, Bio? 1.	A. Calculus	
1. Particle Kinematics 2. Rigid Body Kinematics a) Relative Velocity b) Relative Acceleration 3. Particle and Rigid Body Kinetics a) Force-Mass-Acceleration b) Work-Energy c) Impulse-Momentum 4. Explain how to decide what Method to use by identifying variables	1. Dynamics (Particle and Rigid Body FBD, MAD, Kinematics, Kinetics)	1. Vector Algebra 2. Integration 3. Differentiation	
B. Basic Concepts and Classification of Vibration 1. Elementary parts 2. Degrees of Freedom 3. Types of Vibration	B. Dynamics 1. Coordinate Systems		
C. Spring, Mass, and Damping Elements 1. Equivalent spring 2. Equivalent mass	C. Dynamics 1. Potential energy of spring and gravity 2. Kinetic Energy of mass		
D. Harmonic motion & Analysis of periodic function 1. Definitions 2. Fourier Series 3. Lab on Fourier Series	3. Ability to use spectrum analyzer	D. Mathematics 1. Develop equations of graphs shown 2. Integration over a domain 3. Ability to use Matlab	Writing

II. Unit			
A. Free Vibration of Undamped and Damped Vibration	A. Dynamics	A. Mathematics	
1. Equation of motion from FBD&MAD	1. Force-Mass-Acceleration	1. (Solution of 2^{nd} order ordinary differential equations)	
2. Equation of motion using other methods	2. Conservation of energy		
3. Solution of equation of motion			
4. Examples (how complicated models are simplified)			
5. Reverse analysis (moment of inertia of rigid body from compound pendulum analysis)			
6. Experiment on determination of natural freq. of SDOF	6. Ability to use FFT Analyzer Some digital signal processing issues		Writing
B. Free Vibration of Damped System	B. Dynamics	B. Mathematics	
1. Viscous Damping	1. Force-Mass-Acceleration	1. (Solution of 2^{nd} order ordinary homogenous differential equations)	
2. Damping ratio, under,critical,& over damped			
3. Log decrement, energy dissipated			
4. Other types of damping			
III. Unit			
A. Harmonically Excited Vibration of SDOF	A. Dynamics	A. Mathematics	
1. Response of an undamped system	1. Force-Mass-Acceleration	1. (Complementary Solution and particular integral of non-homogenous diff eqns)	
2. Response of a damped system	2. Same	2. Same	
3. Quality factor and bandwidth			
3. Base Excitation			
4. Transmissibility and Vibration Isolation	3. Same	4. Same	
4. Rotating unbalance	4. Same	4. Same	
IV. Unit			
A. Forced vibration of SDOF subjected to general Vibration conditions		A. solution of diff. eqn	
1. Response under periodic force			
2. Response under transient force			

V.	Unit			
	A. Two Degree of Freedom Systems	A. Dynamics (Force-Mass-Acceleration)	A. Matrix algebra	
	B. Concept of natural frequencies and associated Mode shapes			
	C. General eigenvalue problem		C. Matlab solutions	
	D. Determination of natural frequencies And mode shapes	D. Understand how FRF is used to obtain modal properties	D. Complex matrix algebra	
	E. Steady State response due to Harmonic excitation - Direct method			
VI	Unit			
	A. Multiple Degree of Freedom Systems			
	B. Eigenvalue Problem			
	C. Orthogonal property and mass normalization of modes			
	D. Vibration of undamped systems using modal Analysis			
	E. Lab on MDOF			Writing
VI.	Unit			
	A. Vibration Isolation	Same		
	B. Tuned Absorber			

Table B.5.a.3.2: Content Schedule and Styles, Models, Bloom's Analysis

Week	**Content Topic:** *Factual, Conceptual, Procedural, Meta-cognitive*	**Content Source** *Text, etc.*	**Teaching Style** *a-k; fpfd*	**Learning Style** *CE, AE, AC, RO*	**Teaching Model** *1-24 name*	**Dale's Cone** *Active or Passive*	**Bloom's Traditional** *Evaluation, Synthesis, Analysis, Application, Comprehension ,Knowledge*	**Bloom's Revised** *Create, Evaluate, Analyze, Apply, Under stand, Remember*	**Critical Thinking High (H), Medium (M), Low(L)**	**Centered?** *Teacher, Knowledge Assessment, Learner*
1	Introduction	Prof.	a,b	AR	Lecture, Concept formulation Conceptualization	passive	knowledge	PK	H	
	Review of Dynamics	Prof, Dyn text	a,b,d,f	AA	Advance organizer	Passive, active	Comprehension,	MK	H	
	Basic Concepts	Prof, Text	A,b	AR,aa	Lecture	passive	knowledge	CK	M	
2	Equivalent Spring, mass	Text	A,b,d	AR,AA	Simulations	passive	application	PK	M	
	Harmonic Motion	Text	A,b	AR	Lecture	passive	comprehension	CK	L	
	Fourier series	Text	A,b,f	AR	Lecture	passive	comprehension	PK	M	
3	Free Vib of SDOF Undamped Translational syst, Lab on Fourier series	Text Manuals, Tutorial	A,b,f,c	CR,CA,AR	Lecture Cooperative Learning	Passive, active	comprehension	PK	H	
	Free Vib of SDOF Undamped Rotational syst	Text, prof	A,b	CR	Lecture	passive	knowledge	PK	M	
	Examples	prof	A,b,f	AA	Conceptualization	passive	application	PK	M	
4	Free Vib of damped syst., damping ratio,	text	A,b	AA,AR	Lecture	passive	comprehension	CK	H	
	Log Decrement, Energy dissipated	text	A,b	AA	Lecture	passive	knowledge	PK	M	
	Other types of damping	Text prof	A,b	CR	Lecture	passive	knowledge	PK	M	
5	Response of undamped syst. excited harmonically,	Text Manuals	A,b,c,d,f	AR,AA	Lecture, Cooperative learning	Passive, active	comprehension	PK	H	

	Lab SDOF free vib.									
	Response of damped syst. excited harmonically	Text	A,b	AR,AA	Lecture	passive	knowledge	CK	H	
	Quality factor & bandwidth	Text Prof	A,b	AA	Lecture	passive	comprehension	PK	M	
6	Exam#1					active	comprehension	PK	H	
	Base excitation	Text	A,b	AR	Lecture	passive	knowledge	CK	M	
	Transmissib, Isolation	Text, Prof.	A,b	AR,AA	Lecture, concept Presentation, conceptualization	passive	comprehension	PK	H	
7	Rotating Unbalance	Text	A,b	AR	Lecture	passive	knowledge	CK	M	
	Review					Passive,active	application	MK	M	
	Response of SDOF sub. to Periodic force	Text	A,b	AR	Lecture	passive	comprehension	CK	M	
8	Response of SDOF sub. to transient force	Text, Prof	A,b	AR	Lecture	passive	comprehension	CK	H	
	Matlab solutions	Prof.	A,b,f	AA	Lecture,	passive	comprehension	PK	H	
	Free vib of undamped 2DOF	Text	A,b	AR	Lecture	passive	knowledge	CK	M	
9	Natural freq. & mode shapes	Text, Prof	A,b	AR	Lecture, conceptualization	passive	comprehension	PK	H	
	Coordinate coupling	Text	A,b	AR,AA	Lecture	passive	application	PK	M	
	Review		A,b,f			Passive,active	comprehension	MK	M	
10	Exam#2					active	application	MK	H	
	Steady state response due to harmonic excitation - direct method	Text	A,b	AR	Lecture	passive	knowledge	PK	M	
	Multiple DOF	Text	A,b	AR	Lecture	passive	comprehension	PK	M	
11	Eigenvalue prob	Text,Prof	A,b	AR,AA	Lecture	passive	knowledge	PK	M	

	Orthogonality of modes and mass normalization	Text Prof	A,b	AR	Lecture, conceptualization	passive	comprehension	CK	M	
	Vibration of undamped syst. using modal analysis	Text	A,b	AR,AA,CR	Lecture	passive	application	PK	H	
12	Forced vib. of damped syst, Lab on free vib. of MDOF	Text Prof	A,b,c,d,f	AA,AR	Lecture, cooperative learning	passive, active	application	PK	H	
	Matlab solutions	Prof	A,b,f	AA		passive	comprehension	PK	H	
	Review					passive,active	application	MK	M	
13	NVH issues	Prof.	A,b,f	CR	Lecture, Advance Organizer	passive, active	application	MK	M	
	Single plane unbalancing	Text	A,b	AA	Lecture	passive	knowledge	CK	M	
	Vibration Isolation	Text	A,b	AR	Lecture	passive	comprehension	PK	M	
14	Designing of systems	Prof	A,b,c,d,e,f	CA	Lecture, reciprocal learning, Cooperative learning	active	synthesis	MK	H	
	Tuned undamped absorber	Text	A,b	AA	Lecture	passive	comprehension	CK	M	
	Lab on balancing	Text	A,b	AR	Cooperative learning	active	comprehension	CK	M	
15	Industrial issues	Prof.	A,b	CR	Lecture	passive	analysis	MK	M	
	Review					passive,active	application		M	
	Review					passive, active	comprehension		M	
16	Final Exam or Project					active	comprehension	MK	H	
Note: There is a practice by some professors to give the final exam before or during the **last week of CLASS**, rather than the **FINAL EXAM WEEK**. This essentially means that you are "cheating" the students out of one day of content, learning, etc. We should have 15 weeks of learning, including exam, quizzes, or project days, but to make the **final week of class** the **FINAL exam week** is unethical by NIU standards, regardless of who does it. **What is your practice? I GIVE FINAL EXAM ONLY AT TIME SCHEDULED IN CATALOG (AND NOT DURING FINAL WEEK OF CLASS)**										

Table B.5.a.3.3: Instructional Design Gaps Analysis Table

ABET/ NAIT Standard **a-k Eng** **A-Q Tech**	**NIU General Ed Goals (embedded)** **a-I, ii, iii, iv** **b-I, ii, iii, iv** **c and d**	**Student Learning Objectives listed on syllabus**	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***	**Knowledge Sources** **Professor, Text, Cases, Speaker, References, etc.**	**Student Assessments listed on syllabus**	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***	**Test Items or Projects/ Rubrics**	**Bloom/Dale** ***Evaluation Synthesis Analysis Application Comprehension Knowledge***	**Performance** ***IF any; if none, leave blank***	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***
A, E, I, J		To learn basic theories behind vibrating mass or equipment	Application	Professor, text	Hw, tests	Analysis	Exam2: Prob1, 2,3 Final Exam: Prob2,3,4			
K		To familiarize with various Equipment and software used to run equipment	Comprehen.	Professor, TA, References	lab	Comprehen.				
B, D		To perform experiment to verify the theories	Application	Professor, TA	lab, test	Application	Final Exam: Prob1			
G		To learn how to write a laboratory report	Knowledge	Professor, TA	lab	Knowledge				
C,E,K		To apply major commercially available mathematical and engineering software. Matlab solutions of differential equations in vibration related problems	Application	Professor	hw	Application				
A,C,E,H,J, and K		To design structures where failure from vibration is prevented	Synthesis	Professor, references	Hw, tests	Application	Exam2: Prob2, Finalexam Prob2,4			

INSTRUCTIONAL GAPS ANALYSIS SUMMARY (FALL 2005 AND FALL 2006)
(See Professor Examples, B.5.b, 1,2,3; also, Program in A.5 and Worksheets, Section C)
Jule Dee Scarborough, Ph.D.

Student Learning Statements (Outcomes)
In the initial analysis of the Fall 2005 courses – where we began, professors used their existing course syllabi. Although as a college we had improved our student learning statements during the accreditation process, they remained rather unorganized and weak in content and appropriate expression. The learning statements were expressed in mixed modes across syllabi. Some learning statements were written as course objectives; others were written as student learning objectives; yet others were written as more outcome-oriented statements. However, in generalizing, many and sometimes most of the student learning statement formats across syllabi were not active, clear, measurable, or clearly outcomes-oriented, where the professor and student could ascertain exactly what was expected and would be measured and/or determine the culminating grade. Three professors expressed the learning statements in a way where students could see that there was a relationship between student learning outcomes and the ABET or NAIT outcomes, but if the ABET or NAIT outcomes were identified by a letter and not stated, then the relationship was not clear, nor were students about to review the accreditation outcomes for their own information. Two professors expressed the statements more clearly, with written statements for both the national standards and the learning outcomes for the course. The other five professors did not show the national statements in narrative but rather identified them by letter or number, regarding the level of coverage and depth of relationship. This had little meaning for students and did not make it easy for the professors to clearly be assured of direct links and relationships. Generally, the statements did link to the ABET or NAIT standards or outcomes, but often not clearly or strongly. It would have been difficult to determine a direct link, especially in light of the student learning assessments being used for the 2005 course. Therefore, we examined the 2005 syllabi and course content related to the standards as well as we could, with the understanding that the student learning outcomes to be redeveloped would better and more clearly and directly link to the national standards and assessments – a two-way link revealing the critical knowledge and skill connections.

Below are two charts that broadly identify the standards addressed in the Fall 2005 courses, according to the content and syllabus analysis by each professor of his/her course. The data are presented (in black) as collapsed across either all engineering professors or engineering technology professors as a broad viewpoint. The **Fall 2006** courses are presented in red, and although there are minor differences in the number of standards addressed, there is a great and very significant difference in the quality of the learning statements and their direct links to both the national standards and the learning assessments. The tables also reflect the number of learning outcomes for each standard by professor, **2005-2006** when possible. For the **2006** courses, the professors not only have improved wording and expression, but the knowledge and skill connections are much stronger; in addition, the outcome statements are improved because they are broken out into primary, second, and third level statements. The quality is improved not only because of better wording, but also because they now better understand the difference

between complex statements, where there is a cluster of outcomes inherent to a single primary outcome statement. Thus the course content or the knowledge and skills to be taught became more obvious in the inherent breakouts of second and sometimes third level outcomes. This provided insight and assisted the professors in understanding what underlying or inherent knowledge and skills were required for a complex cluster of difficult primary learning outcomes – in other words, the knowledge and skills inherent to a single complex primary outcome. Therefore, readers may be amazed at the number of changes that resulted.

Usually, the primary statements would be used on syllabi or other reporting documents, but the analysis and breakout of second or third level learning statements provided a great learning experience for professors and led them to design and then engage students in more intentional, thoughtful, and higher quality learning experiences. This analysis and process can lead to more astute teaching and student learning, student assessments, instructional choices, learning process decisions, and more. Remember, each <u>course</u> is not required to address every national standard or outcome, but instead the standards or outcomes of focus selected should be addressed well. It is important that they understand individual course versus program requirements, that there is a cumulative effect across courses for the entire program, and that the overall <u>program</u> is required to address all national standards or outcomes, not any single course; therefore, many standards will be addressed across multiple courses. However, particular standards may be addressed in only one or two courses across the program, depending on content, depth, program level, (e.g., introductory or capstone course). Professors sometimes mistakenly strive to address all or too many outcomes; thus the course content can become weak or superficial. Finally, when identifying the objectives or outcomes listed below, an * is used where one objective or outcome covers more than one ABET outcome or NAIT standard or where there is a greater total of “1s” than the total in the number in parentheses (4). The determining factor is the level of coverage of content.

Regarding outcomes, it is important to note that the professors analyzed the engineering or technology course content for embedded NIU General Education Goals. This analysis led them to more deeply understand why students fail to perform well in their courses if they do not come to the course with the appropriate general education knowledge and skills that are the underlying foundation for the engineering and technology content. The program leader revealed the strong relationships between NIU General Education Goals (outcomes) and the ABET and NAIT standards or outcomes by aligning and inserting them into a worksheet. That made it much easier and more efficient for the professors to see the direct relationships, to consider the importance of acknowledging the embedded general education goals/outcomes as part of their course content, and to realize that even though they are teaching engineering or technology courses, they are actually concurrently continuing, extending, expanding, and deepening the learning of general education content in the context of engineering and technology. This was extremely important. Our professors intuitively knew this but had never “studied” the connections, mapped the connections, or included the general educational goals aligned beside their engineering or technology outcomes. They had also never thought of themselves as continuing the learning of the general education knowledge and skills in engineering and

technology content. They considered the general education math, science, and communication knowledge and skills as prerequisites and only dealt with them when students did not have the knowledge or skills needed to perform on the engineering and technology content. Now the professors understand that they actually continue the learning of the mathematics, science, communication, etc. content in the engineering and technology context. The chart below reflects the 2005 course in black and the changes for the **2006** course in red. The professors improved the outcomes and connections and are committed to greater depth of change for the future. This was a very successful program component, resulting in significant learning and change.

Assumptions

Beware of assumptions when scanning the chart below and noting that one or more course outcome numbers did not seem to change. For example, one professor's number of outcomes did not change from 2005-**2006**; however, the quality of the outcomes for **2006** was very significantly different and improved. Also that professor's four primary outcomes were broken out into second and third level outcomes. Again, for example, one primary outcome inherently encompassed five secondary outcomes, with each of those broken out into a third level. Thus the quality in content, linkages, and assessments was dramatically different and greatly improved for most of the courses.

Table B.5.b.1: Standards ABET-Engineering Outcomes (Fall 2005 and Fall 2006 courses) (5 engineering professors)

a. apply math, science, engineering	b. design/ conduct experiments; analyze, interpret data	c. design system, component, process-given constraints, etc.	d. function on inter-disciplinary teams	e. identify, formulate, solve engineering problems	f. understand professional, ethical responsibility	g. ability to communicate effectively	h. understand impact eng. Solutions on global, economic, environment, society	i. recognition of need for, and ability to engage in life-long learning	j. knowledge in contemporary issues	k. ability to use techniques, skills, and modern engineering tools
Fall 2005 and Fall 2006 Courses – ABET Outcomes										
5 + 5+	2+ 1partial (no DOE) 1 NR 1 c 2+	4 + 1+partial (could do lots more) 1 c 4+	1+ 1 NR 3 c 2+	4+ 1c 5+	1+ 1+ (written reports only) 1 NR 2c None	1+ 1 3c 3+	1+ 1 NR 2c 1c (minor) 1+	2+ 1+ (to small effect) 2c 2+	4+ 1c 4+	4+ 1+ (students don't use unless asked to) 5+
(6-11) 1 - 4 (3/6--5) 1-5 (4-4) 1 - 1 (4-5) 1 - 5 (4-5) 1 - 2	1 - 1 * -none	1 - 2 1 - 1 1 - none 1 - 5 1 - 1	1 - 1 * - none 3	* - 8 1 - 5 1 - 1 1 - 5 1 - 1	 * - none * - none * - none	1 - 1 * - 1 1 - 3	1 - none * * - none	* - none * - 1 * - 1	* - 2 * - 1 * * - 1 1 - 1	* - 3 1 - 1 1 - 1 1 - 2 1 - 1

Legend: + = yes-okay; c = need to consider; other notes

Table B.5.b.2: Standards ABET/TAC/NAIT-Engineering Technology & Industrial Technology
(2 engineering technology/technology professors) (Fall 2005 and Fall 2006 courses)

a. mastery of knowledge, techniques, skills, modern tools	b. ability to apply current knowledge; adapt to emerging applications of math, science, technology	c. ability to conduct, analyze, interpret experi-ments; apply experimental results to improve processes	d. ability to apply creativity in design of systems, components, processes	e. ability to function effectively on teams	f. ability to identify, analyze, solve technical problems	g. ability to commu-nicate effectively writing	h. ability to com-municate effectively orally	i. recognize need for, ability to engage in lifelong learning	j. ability to under-stand profes-sional, ethical, social responsibilities	k. respect for diversity; know-ledge of contemporary profession-al, societal, global issues	l. commit to quality, timeliness, continuous improve-ment	m. ability to program computers and/or use computer applications effectively	n. ability to use modern labor-atory tech-niques, skills, equip-ment effect-tively	o. ability to manage projects effect-tively	p. ability to design, mani-pulate, manage industrial systems q. ability to manage or lead person-nel effect-tively
Fall 2005 and Fall 2006 Courses – ABET/TAC/NAIT Outcomes															
2+ **2+**	**2+** **2+**	**1+** **1c** **2+**	**1+** **1c** **2+**	**1+** **1c** **None**	**2+** **2+**	**1+** **1c** **2+**	**1+** **1c** **None**	**1+** **1c** **2+**	**1+** **1c** **1+** **? not sure**	**1+** **1c** **1+**	**2+** **1+**	**2c** **1+**	**1+** **1c** **1+**	**1+** **1c** **None**	**p. 1 no re-sponse 1c** **None** **q. 1no re-sponse 1c** **None**
(5-6) **1-6** **(6-19)** **1-10**	**1 - 5** **1 - 5**	**1- 1** *** - 5**	*** - 1** *** - 3**		**1 - 4** **1 - 6**	**6** **1**		*** - 4** **4**	**2** **1-one**	**1** **1**	**2** ***-none**	**1**	**1 – 1**	***-none**	**p. * -NR** **NR-NR** **q. *-NR** **NR-NR**

Legend: + = yes-okay; c = need to consider; other notes

Table B.5.b.3: NIU General Education Goals (Fall 2005 and Fall 2006) (7 professors across engineering and technology)

Writing	Speaking	Listening	Quantitative Reasoning	Use of Resources-Technology	Historical Development Of Culture	Significance of Arts	Cultural Traditions Philosophical Ideas	Methods in Science Methods in Social Science	Interrelatedness Across Disciplines	Social Responsibility Citizenship
C C+ Earlier it was only lab reports. In fall 06, they had to write reports for three PA tasks.	**C C+ Presentation of PA tasks**	**+ + Listen to guest speaker, professor, fellow students during PA task presentations**	**+ C+ Homework, exams, PA tasks – all involved quantitative reasoning**	**+ + In addition to labs that required using many resources, had to use outside resources for PA tasks.**	**NR NA**	**NR NA**	**NR NA**	**NR NA**	**NR C May consider more interaction with EE for signal processing**	**NR C+ Discussed issues such as energy conservation, noise, pollution, ethics, etc.**
C+ Did consider and add, still needs improvement; will keep working on it	**C**	**?**	**C+ Strong, but could be better**	**+ I'm quite pleased**	**NA**	**NA**	**C-**	**C+**	**C**	**C**
Ok + Project, exams, homework, using MS Word	**C + Oral presentations with PowerPoint**	**C C-**	**Ok + Material requires this**	**Ok + Software and computer to solve problems**	**NR NA**	**NR NA**	**NR NA**	**C NA**	**Ok, C+ Examples, exercises with topics from other disciplines**	**C C-**
+ + PAs and homework	**+ + Pas and discussion sessions**	**+ + Lectures, case studies, discussion sessions**	**+ + Problem solutions, homework, midterm and final exams**	**+ + PAs and homework**	**C NA**	**C NA**	**C NA**	**+ + Problem solutions, homework, midterm, final exams, and PAs**	**+ + Case studies and PAs**	**+ C-**
C - + well addressed through PA reports	**+ NA- possible to include for future course**	**C + lectures**	**+ + addressed in project design decisions**	**C + well addressed through project design decisions**	**NR NA**	**C + addressed through project design**	**NR - NA**	**C + well addressed through project design**	**C C+ to some extent when making design decisions**	**C C- possible to include for future courses**
+ + Performance Tasks	**+ + Group learning and interactions**	**+ + Group interactions**	**+ + Performance tasks, lab demonstrations**	**C NA**	**+ C+**	**C + Lectures**	**+ C+**	**+ NA**	**C C+**	**+ C+**
C +	**C C-**	**C C-**	**+ N+**	**+ +**	**+ NR**	**C NA**	**C NA**	**+ NA**	**C NA**	**C N\A**

Legend: + addressed well; NA-does not really apply in professor's opinion; C- do not do it, but still need to consider adding it in as professor continues to make changes; C+ did consider and add in; still needs improvement and professor will keep working to improve or add;

Research Semester Results on Teaching Styles (Fall 2005 and Fall 2006)

During the initial course analysis, professors analyzed their 2005 courses for use of teaching styles. They referenced Mosston and Ashworth (1990) only. At the end of the research semester, professors were provided the same Teaching Styles list by Mosston and Ashworth and also Grasha's (1996). They were asked to consider which styles were used during the research semester. The responses ranged from check-offs to comments. Mosston and Ashworth's styles are compared for the 2005 and 2006 courses on (Table 5) below the one for Grasha (Table 4). Some professors estimated how many times they used each style; others made comments about the ones they choose; and others did both. All professors made comparisons using Mosston and Ashworth's teaching styles, but some professors also considered Grasha's. (Mosston and Ashworth were provided during the initial analysis early in the program. Later in the program we were trying to present them with varying options and perspectives. Therefore, they were also exposed to Grasha's styles.) The most important aspect of this reporting activity was to reinforce consideration of teaching styles and to stimulate a broader repertoire of teaching styles or the use of a greater variety of teaching styles in their courses. Grasha is presented first. **Note: Outcomes vary across professors, so the two tables, Grasha and Mosston and Ashworth, reflect which teaching styles are used across the total of individual primary course outcomes by professor. Outcomes are presented by number only in left column. This program component was very successful in that professors varied their teaching styles beyond those used in their 2005 courses.**

Table B.5.b.4: Student Learning Outcomes & Teaching Styles (Fall 2006) (7 professors across engineering and technology)

# of Outcomes	Expert	Formal Authority	Personal Model	Facilitator	Delegator
6	**Yes -4**	**Yes – 5**	**NR**	**Yes – 6**	**Yes - 3**
3-6	**Used Felder formally**	**NR**	**NR**	**NR**	**NR**
	Responded to Kolb				
4	**Yes**	**Yes**	**NR**	**NR**	**NR**
	Used Kolb formally				
4	**Yes, but used less this time**	**Used for fundamentals**	**NR**	**Used with PA tasks, especially 1 & 2**	**Used for final PA task #3**
	Used Kolb formally				
5	**No Response to Grasha**	**NR**	**NR**	**NR**	**NR**
	Responded to Kolb				
6	**No Response to Grasha**	**NR**	**NR**	**NR**	**NR**
	Responded to Kolb				
4	**Yes**	**Yes**	**No**	**Yes**	**Yes**
	Responded to Kolb				

Table B.5.2.5: Student Learning Outcomes & Teaching Styles (Fall 2005 and Fall 2006)
(7 professors across engineering and technology)

# of Outcomes	Command	Practice	Reciprocal	Self-Check	Inclusion	Guided Discovery	Convergent Discovery	Divergent Production	Learner Designed	Learner Initiated	Self Teaching
6	6+ yes -10	6+ yes-4	2c, 4+ yes -5	6c-1 min.	6c	5+, 1c yes -20	6c	3c (min) 3c yes -6	6c	6c yes -1	6c
3-6	6+ Less than before	6c Much more	5c, (1 little) a few times; did not guide ob.	6c more than normal	6c	3+, 3c more than before	1 can do more 1+, 4c more than before	5c, 1 little	6c	6c more than before	6c more than before
4	2ok yes	2ok,c yes	2c yes	2c	2c	NR	2c yes	NR	NR	NR	NR
4	4+ used less this time	4+	2c, 2+ used much more during oral discussions	4c	4c new, somewhat accomplished through implementation of the rubrics	4c	4c used much more – a lot through PA tasks, discussions	4c	4c	4c	4c
5	5+	5 some used appx. 6 times mainly/PAs	NR	4+ (1 some)	4c, 1NR	3c, 2NR	3c, 2NR	NR used appx. 12 times / problem solving	NR	4NR,1c	NR
6	5+, 1c yes - 20	5+, 1c yes - 6	6c yes - 6	6c	6c	3+, 2c	5c, 1+ yes - 3	5+, 1c	5c, 1+	6c yes - 3	5+, 1c
4	4+ no; but, yes with other styles below	4+ yes, when solving problems in class	4+, c within the group; but without professor supervision	4c yes; feedback within group	NR yes	4c+	4c+ yes	4c yes, sometimes; when the was design problems	4c yes	4c yes, but with some guidelines; instruction is given	4c yes, with projects; but not with deep consultation

*Research Semester Teaching Models (Fall **2006**)*
In the table below, the professors' analysis of their Fall 2005 course is compared to what they indicated actually occurred in the same, but significantly revised, course during the research semester of Fall **2006**. The Fall 2005 course is presented first in black, and beneath that information, the teaching models used during the Fall **2006** course during the research semester are presented in red. There are 24 teaching models; therefore, the complete list is presented in two charts; models are identified across the first row. The numbers in black represent what they would consider using, acknowledging that in the 2005 course those were not in use. The number or comments in red represent what they felt they tried in the 2006 experimental course.

Although it may appear that professors selected only a few new models to use during their experimental course in 2006, remember there are 24 different models to consider. They were encouraged to select just a few models to try out in the 2006 courses, and then to add other models gradually in consecutive semesters. Thus, each professor chose a few models to try that were different than the most-often used "lecture" model.

This aspect of the program was successful: professors were exposed to 24 teaching models. They used this initial approach to analyze what models they felt were used in the 2005 course. Most of them had no previous knowledge of these models nor had they considered "teaching models" at all, even those who had attended teaching workshops. Several had been exposed to "cooperative learning," one of the teaching models below, but had not used the model formally at all and only weakly structured informally.

During the teaching model program component, the professors studied the 24 models more in depth; this was after the initial analysis with a list and brief descriptions. The worksheet used as a study guide along with the Joyce, Weil, and Calhoun's (2004) *Models of Teaching* book reveal how they felt about each model and whether they felt each model had potential for use in teaching their course. That worksheet is presented later, as it is a formal segment of the program for the redevelopment of the course. However, when reviewing the worksheet, each professor's comments, and then the comments after the experimental course, one can see the growth, comments, or questions.

After the research semester, Fall 2006, we returned their initial analysis and the study worksheet and asked them to note which teaching models they felt they had actually used during the experimental semester. Did they use the ones that they expected to try out? Did they use others not expected? The red numbers below labeled 2006 are those responses. The data reveal significant change, considering the context was one course and their first effort to expand their teaching model repertoires.

(See Teaching Models In Portfolio Section B.11)

Table B.5.b.6: Student Learning Outcomes & Teaching Models (Fall 2005 & Fall 2006) (7 professors across engineering and technology)

# Out-comes	Memory	Progressive Part	Advanced Organizers	Lecture	Reciprocal Teaching	Mastery Learning	Cooperative Learning	Graphic Organizers	Concept Attainment	Concept Formation	Concept Presen-tation	Conceptual
6	6c	6c	5c,2+ yes 20+	6+ yes 10	6c (1 min.)	5c, 1+	3+, 3c yes 3	3+, 3c (1 min) yes 4	6c (1 min)	6c (1min)	6c	3+,3c yes 6
3-6	6c	6c couple times liked it	6c have always used it	6+ do much less	6c several times	6c used, not completely rigorous	6c used much more & more formal	6c (1 min) used about as much as before	5c,1+ used…probably slightly more	6c	6c used a little	6c used
4	NR	2c yes 14	2c yes	2+ yes 14	2c yes 7	2c yes 10	2ok,c yes 7	2c	NR	NR	2c yes	2c
4	NR	NR	NR yes, good response	4+ yes, several times	2c, 2+	NR	2c, 2+ yes, good response, more assessments taken the time	4c	4c	4c	4c *Used with *C, more often than before; now I know what this is called.	4+ **** used with * CP
5	2+	4+	4+	4+ 20-used frequently to deliver course materials	4c 3-used while executing PAs; demon-strated good outcomes.	NR	4c 3- used to enhance implementation of PAs	4+	NR	NR	3c,1NR	4c
6	5c	4+,2c 15 lectures	4+, 2c 3 theory linked with lab demon-stration	5+, 1c 20 lectures	6c	6c	6c 6-group learning & PA #3	5+,1c 10-during lectures-visual aids	6c	6c	2c, 4+ 6-lectures on funda-ment	4+,2c
4	4c used, but not much	4+ yes	4+ yes	4+ some parts lecture, but not majority	4c did this with projects	4c	4+ yes, done with PA projects	4c yes, every group did that	4c	4c	4+	4+

# Out-Comes	Inductive	Deductive	Inquiry	Simulation	Jurisprudential	Direct Instruction	Training	Synectics	Psychomotor	Metaphore	Non-Direct	Role
6	6c yes 4	6c (1 min)	6c(2 min) yes 5	6c(2 min) yes 2	6c	4+,2c(1 min) yes 8	4+, 2c yes 5	6c	5NR,1c yes 2	NR yes 1	NR yes 2	NR yes 2
3-6	6c used a lot	6c used less than before	2+, 4c used a lot	6c extensive use	6c	6c	1+, 5c about as before	6c	6c some	6c	6c	6c
4 NR→	NR	2ok	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
4	4+ used much more; students responded well! Used past also.	4+ used much more; students responded well! Used past as well.	NR	4c	NR	NR	NR done some before; useful for problem solving procedures; excellent / conceptualization; able to discuss different approaches after one as presented.	NR	NR	NR	NR	NR
5	NR	NR	4+ 7	4c	NR	4c 10 suitable for certain topics	1c, 4NR	NR	NR	NR 3	4c	1c, 3NR
6 .	6c 9 – Pas & Assignments	6c	6c	4+, 2c 2 lab demos	6c	2+, 4c 15 lectures on basics	5c, 1+ 2 lab demos	6c	5c, 1+	6c	6+	5c, 1+
4	4c yes, hidden in lecture	4+ yes, but professor dos that when needed	4c	4c yes, students simulate performance of rubrics	4c	4c	4c	4c	4c	4c	4c	4c

(Scarborough, 2006 based on Joyce, Weil, & Calhoun, 2004)

Student Learning Outcomes & Kolb (1984) Learning Styles

The Chart below identifies what learning styles, according to Kolb's (1984) styles, the professors felt they were providing opportunity for students to use in both the 2005 and **2006** courses. It appears that more attention was paid to learning styles across professors in the 2006 experimental course. Two professors used the Kolb Learning Styles inventory formally with the entire class, and a third professor used the Felder Learning Styles Inventory formally with his/her class. This segment of the program was also considered very successful, as it greatly enhanced the professors' understanding of the overall focus of teaching and the relationship between teaching styles, teaching models, and student learning styles. Their awareness was greatly increased; their understanding increased; and, their commitment to working on increasing the diversity of teaching models and styles to better engage a broader range of student learning styles and to also culminate in expanding individual student learning styles was significant. Below are reflections from the three professors who formally used LS Inventories. (See Felder notes)

Table B.5.b.7: Student Learning Outcomes & Kolb Learning Styles 2005 & 2006 (7 professors across engineering & technology)

# Outcomes	Concrete Experience	Abstract Conceptualization	Active Experimentation	Reflective Observation
6 **Also used Felder's SL, IL, VL, VL, AL, RL, GL.**	**2c-minimal, 2c, 2+** **yes**	**5+, 1c** **yes**	**3c, 3+** **yes**	**6c** **yes**
3-6 **Used Felder's only. The notes are true for the concept tests, but less so on the problem solving tests. See write up below.**	**6+** **Global learners did better than sequential learners.**	**3+, 2c** **Intuitive learners did Better than sensing learners.**	**4+, 2c** **Visual and verbal learners did equally well.**	**3+, 1 not so much, 2c, 1 a little** **Reflective learners did better than active learners.**
4 **Formally used Kolb with students as a way to show students their learning styles. Will use it next time to also create activities tailored to students' distribution of L. styles.**	**NR** **yes**	**2ok,c** **yes**	**2ok, c** **yes**	**2c** **yes**
4 **Formally used Kolb's Inventory.**	**2c, 2+** **Yes** **Concentrated effort was**	**4+** **Yes** **made to have activities**	**4+** **yes** **to engage all four (4)**	**4+** **yes** **learning styles.**
5	**5+**	**1NR, 1+, 3c**	**1NR, 1c, 3+**	**4+, 1c**
6 **No response**	**6c**	**5+, 1c**	**yes**	**4+, 2c**
4 Also used Felder's SL, VL, VL, AL, RL, SL, GL	**4+**	**4+** **yes**	**5c, 1+** **2c, 2+ yes**	**2c, 2+**

Legend: **Black-Kolb 2005 course analysis;** **Red-2006 course analysis;** **Blue-2006 course using Felder**

Reflections on using Felder & Soloman Learning Styles

B.D. Collar

In the fall of 2006, we conducted a research project experimentally investigating student learning in an introductory engineering mechanics course. As part of the project, we administered Felder and Soloman's Index of Learning Styles. The survey is designed for engineering undergraduates. It consists of 44 questions aimed at illuminating students' preferred modes of learning. Felder and Soloman characterize student learning styles with four dimensions:

1. *active vs. reflective,*
2. *sensing vs. intuitive,*
3. *visual vs. verbal,*
4. *sequential vs. global.*

In the research project, we randomly split the class into two groups. With one group, we used hands-on manipulatives to present many of the concepts. The second group is a control group in which we used more traditional graphical techniques to introduce and solidify concepts.

As it turned out, there was no statistically significant difference in the two groups' performances on objective performance tests. However, when we examined the data more closely, we did find an interesting distinction. Electrical engineering students in the experimental group did significantly better than their counterparts in the control group. It was an effect not present in the mechanical engineering students, who make up the bulk of the class. In fact mechanical engineering students in the control group tended to do slightly better than their counterparts in the experimental group, but not by a statistically significant margin.

It is apparent from our data that electrical engineering students think and learn differently than mechanical engineering students. An obvious question is what makes the electrical engineering students more receptive to the hands-on teaching strategy? When we correlated students' learning styles to exam performance, we found that

1. *Reflective learners tended to perform better than active learners.*
2. *Intuitive learners tended to perform better than sensing learners.*
3. *There was no correlation between the visual/verbal dimension of learning and exam performance.*
4. *Global learners tended to perform better than sequential learners.*

In results 1, 2, and 4 above, the p-values were all less than 0.002. However, all correlation coefficients had magnitudes on the order of 0.4. Therefore, while certain learning styles showed a tendency for better performance, it is clear that there was no definite one-to-one correspondence. So are the more advantageous learning styles more prevalent in electrical engineering students? The answer is no.

We found no statistical difference between the learning styles of electrical and mechanical engineering students. In the study, we tested for several other differences between mechanical and electrical engineering students that also correlated with exam scores. We were not able to find any. For now, the difference is a mystery.

Application of Kolb's Learning Styles to ISYE370

By Reinaldo Moraga

I started my Operations Research class –ISYE370– by giving the Kolb's learning inventory test to my students in such a way that they and I became aware of the type of learning style they used to learn and which other styles they were able to pursue. In addition, Kolb's learning styles helped me to improve the delivery of the teaching.

The test was given to each student in the first class after the presentation of the syllabus. Then I explained to them the importance of recognizing their preferred learning style and how this information could be used for them and me to enrich the learning environment in the classroom. In addition, I tried to connect the importance of this tool with their professional career in terms of communicating in the workforce and collaborating in groups. Step by step, I went through the booklet to let them know how to fill the questionnaire and interpret the results. The students were inclined to think that there was a correct outcome for this test. Therefore, I had to make clear that this was only a way to diagnose a <u>*preferred style*</u> *of learning. Finally, I asked to take the test home, answer the questionnaire, and next class give me a brief essay reporting (a) their preferred learning style, (b) actions they could take to expand their learning into other styles, and (c) which type of activities in this class could produce connection with their preferred and other learning styles.*

Most of the students were able to identify their preferred learning style. To expand their learning styles, most of them reported activities such as "exploring the world around," "reading more books," "doing more [hand work]," "being more sensitive to people's feelings," "trying to make the subject fun while learning," etc. Some interesting comments on how to connect their learning styles with my class were "by becoming personally involved and influencing the others to work together," "to have a review session or a guide study," and "to gather into groups to think out problems."

I found this activity relevant because we may use Kolb's test to help us identify our strengths and weaknesses as instructors, recognize our students' preferred styles, use teaching techniques to require all learning styles, and encourage our students to extend into other styles. Of particularly interest to me as instructor was to learn the use of the learning cycle to design some of my "lectures." The learning cycle consisted of four questions: why?, what?, how? and what if? (Harb, Durrant, & Terry, 1993.) I tried to emphasize in my lectures the answers to these questions because in that way I could reach most of the different learning styles of my students. This framework opened my eyes to the importance of Kolb's learning styles, and because of its practical applications in teaching, I would like to keep using Kolb learning cycles as part of my other classes I teach for the College of Engineering.

Reference:
Harb, Durrant, & Terry, (1993). Use of the Kolb learning cycle and the 4MAT system in engineering. *Education, Journal of Engineering Education,* 70-77.

Use of Kolb's Inventory of Learning Styles
CITL – IENG 475 Fall 2006
Regina Rahn

The Kolb Learning Style Inventory was administered to students in the Fall 2006 IENG 475 Decision Analysis class. They completed the questionnaire and interpreted their learning styles. We discussed, as a class, the strengths of each learning style and talked about the types of activities that were useful for facilitating learning of each type. The idea was to set a premise for the assessment and instructional activities that would be implemented during the semester.

In addition, we discussed ways that individuals could use the knowledge of their learning styles to expand the ways in which they learn to incorporate other styles. The discussion included the use of group work (cooperative learning) and peer review as ways to aid in accomplishing this goal.

A graduate student used this as one of the bases for her graduate project. The project was completed at the end of the semester. The IENG 475 students were surveyed about their thoughts in regard to the use of the learning style inventory. The responses were extremely positive, and they definitely saw the value in the exercise.

The Decision Analysis class also posed a unique opportunity for discussions surrounding learning styles. We investigated relationships between learning styles and peoples' attitude toward risk, which is a key element in the course subject matter. I intend to continue utilizing learning style inventories in my courses.

Student Learning Outcomes & Bloom & Dale (Fall 2005 and Fall 2006)

The professors analyzed their student learning outcomes against Bloom's Learning Dimensions and Dale's Cone of Learning. The analysis of the 2005 course is presented in black below and also as a composite, number of outcomes achieving what level on Bloom's and Dale's models. The 2006 course analysis, however, is presented in red. Dale's levels are presented by number of outcomes and level of the Cone. For Bloom, each outcome is listed at the level achieved. This program component was also successful. The professors really seemed to grasp Bloom's intentions, whether traditional or revised. They not only benefited from using it as an analysis tool, but in the later re-development of their courses. They also grasped Dale's intentions about passive versus active learning. These models seemed to build good initial awareness, which deepened as they used them as tools more and more, beginning with the initial 2005 analysis and then as a metric for the re-development of the 2006 courses. There was significant change in the quality of their student learning outcomes. The professors' student learning outcomes were developed and written to achieve higher cognitive processing levels on Bloom's Cognitive Dimension. T he outcomes also reflective higher quality in that they reflected more active learning. The outcomes reflected a potentially higher level of critical thinking as well. This program component resulted in significant change and left them with simple tools to use as metrics for ongoing change and quality checks.

Table B.5.b.8: Student Learning Outcomes & Bloom & Dale (Fall 2005 and Fall 2006)
(7 professors across engineering and technology)

# Outcomes: **05 reported as composite** **06 reported- specific outcome**	**Dale's Cone Levels : P AA+**	**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**	**Critical Thinking Level: L M H**
(1) 6 outcomes composite **1-11 numbers 1-11**	**NR** **1-11** **(8-10) A+**	**1+, 5NR**	**2+, 4NR**	**2+, 4NR**	**1c, 5NR** **1, 3, 7. 8. 9**	**1+, 5NR** **2, 5, 6, 7. 10, 11**	**6NR** **1, 4**	**2Lm 3M, 1H**
(2) 3/6 **5**	**3P, 1A** **2A-** **1-5** **(10) A+**	**6+**	**6+**	**3+, 3c**	**5c, 1NR**	**6c**	**6c** **1-3/6**	**2L, 2L+, 1L/M, 1M; 2Mc**
(3) 2 **2**	**2 PA-C** **1-2** **(8-10) A+**	**2 +c**	**2 +c**	**2+c**	**2 +c**	**2 +c**	**2c** **1, 2**	**2Mc**
(4) 4 **5**	**2A, 2A+** **NR**	**4+** **NR**	**4+** **NR**	**4+** **NR**	**4+** **NR**	**1c, 1+-, 2+** **NR**	**4c** **NR**	**2M, 2H**
(5) 5 **19**	**2P, 2A, 1A+** **1 (6);** **2-3 (9)** **4 (6)** **5-19** **(9-10)A+**	**2+, 3NR** **NR**	**2NR, 3+** **NR**	**2NR, 3+** **NR**	**NR** **NR**	**NR** **NR**	**NR** **NR**	**3M**
(6) 6 **6**	**4P, 2A** **3 (2)** **4 (1,3,5)** **8-9 (1)** **8 (1)**	**2+, 4c**	**3+, 3c** **1, 2, 3, 5**	**5+, 1c**	**4+, 2c**	**5+, 1c** **4**	**4c, 2+** **6**	**3L, 2M, 1H**
(7) 4 **4**	**1P, 1P-A, 2A-P** **1-4 (1-10)**	**4+**	**4+**	**1+c, 3+**	**1c, 1c+, 2+** **1**	**2c, 2+** **2**	**2c, 2+**	**2c, 2c+** **3, 4**

Bloom (1956); Anderson & Krathwohl (2001); Legend for Blooms levels: NR = no response; number + = number of outcomes at that level; +c = okay, but still need to consider; c = need to consider achieving; c+ = some positive accomplishment, but still needs work (**e.g., outcome number reported by each Boom level)**
Dale (1969): Legend for Dale's levels: 9-10 = active learning-doing level; 8 = active learning-participating; 3-7 = visual receiving/passive; 2-1 = verbal receiving-passive,
(e.g., outcome number - level)

Table B5.b.1.1: Faculty Sample: GAPS Analysis Summary-Abdel Motaleb

Standards ABET-Engineering

a. apply math, science, engineering	b. design/conduct experiments; analyze, interpret data	c. design system, component, process-given constraints, etc.	d. function on interdisciplinary teams	e. identify, formulate, solve engineering problems	f. understand professional, ethical responsibility	g. ability to communicate effectively	h. undst. impact eng. Sol global, economic, evnir., society	i. recognition of need for, and ability to engage in life-long learning	j. Knowledge in contemporary issues	k. ability to use techniques, skills, and modern engineering tools
√	C	√	C	√	C	C	C	C	√	√

NIU General Education

Writing	Speaking	Listening	Quantitative Reasoning	Use of Resources-Technology	Historical Development Of Culture	Significance of Arts	Cultural Traditions Philosophical Ideas	Methods in Science Methods in Social Science	Interrelatedness Across Disciplines	Social Responsibility Citizenship
C	C	C	√	√	√	C	C	√	C	C

Student Learning Objectives/Outcomes & Teaching Models

Objectives	Mem	Prog Part	Adv O	Lec	Rec Tch	Mast Learn	Coop Learn	Graphic Org	Concept Attainm	Conc Form	Conc Pres	Con-ceptual	Induct	Deduct	Inquiry	Sim-ulate	JurisP	Direct Instr	Train	Synect	Psycho-motor	Meta-phore	Non-direct	Role
Give students an introduction to semiconductor material properties	C	C	√	√	C	C	√	C	C	C	√	√	C	√	C	C	C	C	C	C	C	C	C	C
Learn the basic theories of modern electronic devices	C	C	√	√	C	C	√	C	C	C	√	√	C	√	C	C	C	C	C	C	C	C	C	C

Apply semiconductor theories to design electronic devices and investigate their performance.	**C**	**C**	√	√	**C**	**C**	√	**C**	**C**	**C**	√	√	**C**	√	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**
Conduct a design project using MathCAD to design different types of devices.	**C**	**C**	√	√	**C**	**C**	√	**C**	**C**	**C**	√	√	**C**	√	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**

Student Learning Objectives/Outcomes & Teaching Styles

Objectives	Command	Practice	Reciprocal	Self-Check	Inclusion	Guided Discovery	Convergent Discovery	Divergent Production	Learner Designed	Learner Initiated	Self Teaching
Give students an introduction to semiconductor material properties	√	√	√, C	C, √		C, √	C, √	C	C	C	C
Learn the basic theories of modern electronic devices	√	√	√, C	C, √		C, √	C, √	C	C	C	C
Apply semiconductor theories to design electronic devices and investigate their performance.	√	√	√, C	C, √		C, √	C, √	C	C	C	C
Conduct a design project using MathCAD to design different types of devices.	√	√	√, C	C, √		C, √	C, √	C	C	C	C

Notes: First symbol means the majority of activity and the second is the minority. √, C means this is mostly done but needs to be refined or activity increased. C,√ means this is not generally done, but sometimes it is.

Student Learning Objectives/Outcomes & Learning Styles

Objectives	**Concrete Experience**	**Abstract Conceptualization**	**Active Experimentation**	**Reflective Observation**
Give students an introduction to semiconductor material properties	√	√	**C**	**C**
Learn the basic theories of modern electronic devices	√	√	**C**	**C**
Apply semiconductor theories to design electronic devices and investigate their performance	√	√	√	√
Conduct a design project using MathCAD to design different types of devices	√	√	√	√

Student Learning Objectives/Outcomes & Bloom & Dale

Objectives	Dale's Cone Levels P A A+	Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Create	Critical Thinking Level L M H
Give students an introduction to semiconductor material properties	**P**	√	√	**√, C**	**C**	**C**	**C**	**C**
Learn the basic theories of modern electronic devices	**P,A**	√	√	√	**C, √**	**C**	**C**	**C**
Apply semiconductor theories to design electronic devices and investigate their performance	**A,P**	√	√	√	√	√	√	**C, √**
Conduct a design project using MathCAD to design different types of devices	**A,P**	√	√	√	√	√	√	**C, √**

Table B.5.b.2.1: GAPS Analysis Summary – IENG 475, Decision Analysis: Regina Rahn

Standards ABET-Engineering

a. apply math, science, engineering	b. design/conduct experiments; analyze, interpret data	c. design system, component, process-given constraints, etc.	d. function on interdisciplinary teams	e. identify, formulate, solve engineering problems	f. understand professional, ethical responsibility	g. ability to communicate effectively	h. undst. impact eng. Sol global, economic, evnir., society	i. recognition of need for, and ability to engage in life-long learning	j. Knowledge in contemporary issues	k. ability to use techniques, skills, and modern engineering tools
V+	V-	V+	C	V+	V	V	V-	V-	V-	V

Standards ABET/TAC/NAIT-Engineering Technology and Industrial Technology

a. mastery of knowledge, techniques, skills, modern tools	b. ability to apply current knowledge; adapt to emerging applications of math, science, technology	c. ability to conduct, analyze, interpret experiments; apply experimental results to improve processes	d. ability to apply creativity in design of systems, components, processes	e. ability to function effectively on teams	f. ability to identify, analyze, solve technical problems	g. ability to communicate effectively writing	h. ability to communicate effectively orally	i. recognize need for, ability to engage in lifelong learning	j. ability to understand professional, ethical, social responsibilities	k. respect for diversity; knowledge of contemporary professional, societal, global issues	l. commit to quality, timeliness, continuous improvement	m. ability to program computers and/or use computer applications effectively	n. ability to use modern laboratory techniques, skills, equipment effectively	o. ability to manage projects effectively	p. ability to design, manipulate, manage industrial systems	q. ability to manage or lead personnel effectively

NIU General Education

Writing	Speaking	Listening	Quantitative Reasoning	Use of Resources-Technology	Historical Development Of Culture	Significance of Arts	Cultural Traditions Philosophical Ideas	Methods in Science Methods in Social Science	Interrelatedness Across Disciplines	Social Responsibility Citizenship
V	V	V	V	V	C	C	C	V	V	C

Student Learning Objectives/Outcomes & Teaching Models

Objectives	Mem	Prog Part	Adv O	Lec	Rec Tch	Mast Learn	Coop Learn	Graphic Org	Concept Attainm	Conc Form	Conc Pres	Con-ceptual	Induct	Deduct	Inquiry	Sim-ulate	JurisP	Direct Instr	Train	Synect	Psycho-motor	Meta-phore	Non-direct	Role
To study the meaning and application of analytic decision making …				**V**	**C**		**C**	**C**	**C**	**C**	**C**	**V**	**V**	**V**		**C**								
To learn a specific set of analytic tools. These tools are applicable to technical decision which …				**V**	**C**		**C**	**C**	**C**	**C**	**C**	**V**	**V**	**V**		**C**								
To become aware of the limitations of the models for rational decision making.				**V**	**V**		**V**	**C**	**C**	**C**	**C**	**V**	**V**	**V**		**C**								
To allow students to practice the structuring and solution of complicated decision problems.				**V**	**V**		**C**	**C**	**C**	**C**	**C**	**V**	**V**	**V**		**C**								

Student Learning Objectives/Outcomes & Teaching Styles

Objectives	Command	Practice	Reciprocal	Self-Check	Inclusion	Guided Discovery	Convergent Discovery	Divergent Production	Learner Designed	Learner Initiated	Self Teaching
To study the meaning and application of analytic decision making techniques for technical decision making under uncertainty.	V	V	C	C	C	C	C	C	C	C	C
To learn a specific set of analytic tools. These tools are applicable to technical decisions that must be made when present or future states of nature are uncertain, and multiple attributes are considered. Included in these methods are decision tree methodology and utility theory.	V	V	C	C	C	C	C	C	C	C	C
To become aware of the limitations of the models for rational decision making.	V	V	V	C	C	C	C	C	C	C	C
To allow students to practice the structuring and solution of complicated decision problems.	V	V	V	C	C	C	C	C	C	C	C

Student Learning Objectives/Outcomes & Learning Styles

Objectives	Concrete Experience	Abstract Conceptualization	Active Experimentation	Reflective Observation
To study the meaning and application of analytic decision making techniques for technical decision making under uncertainty.	C	V	V	V
To learn a specific set of analytic tools. These tools are applicable to technical decisions that must be made when present or future states of nature are uncertain, and multiple attributes are considered. Included in these methods are decision tree methodology and utility theory.	C	V	V	V
To become aware of the limitations of the models for rational decision making.	V	V	V	V
To allow students to practice the structuring and solution of complicated decision problems.	V	V	V	V

Student Learning Objectives/Outcomes & Bloom & Dale

Objectives	Dale's Cone Levels P A A+	Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Create	Critical Thinking Level L M H
To study the meaning and application of analytic decision making techniques for technical decision making under uncertainty.	A	V	V	V	V	C	C	M
To learn a specific set of analytic tools. These tools are applicable to technical decisions that must be made when present or future states of nature are uncertain, and multiple attributes are considered. Included in these methods are decision tree methodology and utility theory.	A	V	V	V	V	V-	C	M
To become aware of the limitations of the models for rational decision making.	A+	V	V	V	V	V	C	H
To allow students to practice the structuring and solution of complicated decision problems.	A+	V	V	V	V	V	C	H

Table B.5.b.3.1: GAPS Analysis Summary

(+ means OK, C means may be Considered in future)

Standards ABET-Engineering

a. apply math, science, engineering	b. design/conduct experiments; analyze, interpret data	c. design system, component, process-given constraints, etc.	d. function on interdisciplinary teams	e. identify, formulate, solve engineering problems	f. understand professional, ethical responsibility	g. ability to communicate effectively	h. undst. impact eng. Sol global, economic, evnir., society	i. recognition of need for, and ability to engage in life-long learning	j. Knowledge in contemporary issues	k. ability to use techniques, skills, and modern engineering tools
+	+ (not much design of expt)	C (only to small extent is done now)	C	+	C	+ (so far only written reports)	c	C (only to small extent is done)	+	+

Standards ABET/TAC/NAIT-Engineering Technology and Industrial Technology

a. mastery of knowledge, techniques, skills, modern tools	b. ability to apply current knowledge; adapt to emerging applications of math, science, technology	c. ability to conduct, analyze, interpret experiments; apply experimental results to improve processes	d. ability to apply creativity in design of systems, components, processes	e. ability to function effectively on teams	f. ability to identify, analyze, solve technical problems	g. ability to communicate effectively writing	h. ability to communicate effectively orally	i. recognize need for, ability to engage in lifelong learning	j. ability to understand professional, ethical, social responsibilities	k. respect for diversity; knowledge of contemporary professional, societal, global issues	l. commit to quality, timeliness, continuous improvement	m. ability to program computers and/or use computer applications effectively	n. ability to use modern laboratory techniques, skills, equipment effectively	o. ability to manage projects effectively	p. ability to design, manipulate, manage industrial systems	q. ability to manage or lead personnel effectively

NIU General Education

Writing	Speaking	Listening	Quantitative Reasoning	Use of Resources-Technology	Historical Development Of Culture	Significance of Arts	Cultural Traditions Philosophical Ideas	Methods in Science Methods in Social Science	Interrelatedness Across Disciplines	Social Responsibility Citizenship
Only lab rep. c	**c**	**c**	**+**	**+**						

Student Learning Objectives/Outcomes & Teaching Models

Objectives	Mem	Prog Part	Adv O	Lec	Rec Tch	Mast Learn	Coop Learn	Graphic Org	Concept Attainm	Conc Form	Conc Pres	Con-ceptual	Induct	Deduct	Inquiry	Sim-ulate	JurisP	Direct Instr	Train	Synect	Psycho-motor
To learn basic theories behind vibrating mass or equipment	c	c	+	+	c	+	c	+	c	c	c	+	c	c minimally	c	c	c	+	+	c	
To familiarize with various equipment and software used to run experiment	c	c	+	+	c	c	+	c	c	c	c	c	c	c	c	c	c	+	+	c	
To perform experiment to verify theories	c	c	+	+	c	C (minimally)	c	C (minimally)	c	C (minimally)	c	c	c	c	c	C (minimally)	c	+	+	c	c
To learn how to write a laboratory report	c	c	c	+	c	c	+	+	c	c	c	c	c	c	C (minimally)	c	c	+	+	c	
To apply major commercially available mathematical and engineering software	c	c	+	+	C (minimally)	c	+	+	c	c	c	+	c	c	C (minimally)	C (minimally)	c	C(minimally)	c	c	
To design structures where failure from vibration is prevented	c	c	+	+	c	c	c	c	C (minimally)	c	c	+	c	c	+	c	c	c	c	c	

Student Learning Objectives/Outcomes & Teaching Styles

Objectives	Command	Practice	Reciprocal	Self-Check	Inclusion	Guided Discovery	Convergent Discovery	Divergent Production	Learner Designed	Learner Initiated	Self Teaching
To learn basic theories behind vibrating mass or equipment	+	+	**c**	**C(only minimally)**	**c**	+	**c**	**C (minimally)**	**c**	**c**	**c**
To familiarize with various equipment and software used to run experiment	+	+	+	**c**	**c**	+	**c**	**C(minimally)**	**c**	**c**	**c**
To perform experiment to verify theories	+	+	+	**c**	**c**	+	**c**	**c**	**c**	**c**	**c**
To learn how to write a laboratory report	+	+	+	**c**	**c**	**c**	**c**	**c**	**c**	**c**	**c**
To apply major commercially available mathematical and engineering software	+	+	+	**c**	**c**	+	**c**	**c**	**c**	**c**	**c**
To design structures where failure from vibration is prevented	+	+	**c**	**c**	**c**	+	**c**	**C (minimally)**	**c**	**c**	**c**

Student Learning Objectives/Outcomes & Learning Styles

Objectives	Concrete Experience	Abstract Conceptualization	Active Experimentation	Reflective Observation
To learn basic theories behind vibrating mass or equipment	**C (minimally)**	+	+	**c**
To familiarize with various equipment and software used to run experiment	+	+	**c**	**c**
To perform experiment to verify theories	**C (minimally)**	+	+	**C (minimally)**
To learn how to write a laboratory report	**c**	+	**c**	**C**
To apply major commercially available mathematical and engineering software	+	**C (minimally)**	+	**C**
To design structures where failure from vibration is prevented	**C**	+	**c**	**C (minimally)**

Student Learning Objectives/Outcomes & Bloom & Dale

Objectives	Dale's Cone Levels P A A+	Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Create	Critical Thinking Level L M H
To learn basic theories behind vibrating mass or equipment				+	**C (minimally)**			**M**
To familiarize with various equipment and software used to run experiment			+					**L**
To perform experiment to verify theories			+					**M**
To learn how to write a laboratory report		+						**L**
To apply major commercially available mathematical and engineering software				+				**M**
To design structures where failure from vibration is prevented						+		**H**

DISCUSSION OF PROFESSORS' 2005 AND 2006 TEST AND TEST ANALYSIS COMPARISONS

Jerry Gilmer, Ph.D.

Each professor submitted copies of the midterm and final exams they used in their classes during the Fall 2005 semester and the corresponding exams they used during the Fall 2006 semester. The Fall 2006 exams were developed during and after formal training in test development; it is expected that the 2006 exams would be improved over the 2005 exams. The professors also learned formal item analysis procedures and generated item analyses for their exams from both Fall 2005 and Fall 2006 semesters. The Test Analysis and Development component of the CEET Faculty Development Program served as a variable to determine program success. Thus, the capability the professors developed to analyze tests and the overall quality improvement of the new tests for the 2006 course were the factors used in the research and evaluation design for the program.

The professors' exams and the item analysis results were compared and some general comments from the comparisons are included below. During the test development training professors learned about different characteristics of good exams, and it is these characteristics that were used for making comparisons from 2005 to 2006. Characteristics of item analysis were also presented to the professors and considered for comparisons.

The discussion below includes a brief statement regarding the meaning of each characteristic and then a brief evaluation related to the changes in tests and item analyses from 2005 to 2006. The characteristics were applied for evaluation to each of the exams and analyses submitted by each professor.

Test Characteristics

Based on Item Bank – Is the exam based on an item bank – a pool of items? During the test development sessions, professors were asked to develop an item bank covering all of the content areas in their course.

> **Evaluation –** It appears that *none* of the exams for 2005 were based on an item bank and that *all* of the exams for 2006 were based on an item bank.

Based on Table of Specifications – Is the exam based on a formal plan, a blueprint, also called a table of specifications? The professors were taught how to create and utilize a table of specifications to ensure the test covers all the intended material in appropriate/specified proportions.

> **Evaluation –** It appears that *none* of the exams for 2005 were based on a table of specifications and that *all* of the exams for 2006 were based on a table of specifications.

Overall Appearance – well laid out; pleasing appearance, grammar, etc. – The exam should be generally pleasing to look at and easy to read and follow. Characteristics such as font selection, spacing, use of highlights such as indents, bold letters, etc. should be considered.

Evaluation – The 2006 exams were *much improved* over the 2005 exams for six of the seven professors. In general appearance, the 2006 exams from one professor looked similar to the 2005 exams.

Overall Instructions – clear, unambiguous – The exam should include some overall instructions to the students and these instructions should appear on the first page of the exam.

Evaluation – Four professors included *very good and improved* instructions for their 2006 exams. Two instructors did not provide any overall instructions and one professor modified the instructions only slightly.

Instructions for Item Subsets – clear unambiguous – Sometimes instructions are necessary for item sets – a group of multiple choice items or a group of short-answer items, for example, or a set of items related to a common diagram or a common reading passage.

Evaluation – Four of the professors included item sets and their instructions for these sets for 2006 were *generally very good*. Three of the professors did not use item sets.

Number of short, discrete items vs. longer items – The test development sessions covered the use of more short, discrete items rather than fewer longer items to ensure that the exam provides an adequate sampling of the course material.

Evaluation – All of the 2006 exams were *improved* on this characteristic. Most professors used long, problem-type items for their 2005 exams but converted to more discrete items for their 2006 exams. Two professors added only a small number of discrete items and still used few, problem-type items.

Number of objectively scored vs. subjectively scored items – Although subjectively scored items (short- or long-answer, problem-type, requiring scorer judgments) are sometimes appropriate, the use of objectively scored items (multiple choice, true-false, etc.) is often preferred. They are easier and more efficient to score, and generally yield a more reliable exam.

Evaluation – All professors (along with using more short, discrete, items) used items that could be objectively scored. Most professors included a few subjectively scored items as well. Two professors used only subjectively scored items on the final exam; one of those did so after discussing the midterm with the class and determining that subjectively scored items were more appropriate to the course content.

Item Quality – clear, direct, well written, no clues – The items should be well-written, using appropriate English, and should contain no clues or cues.

Evaluation – This characteristic is difficult for a non-expert in the content to judge, but generally the exams appeared to be clear and understandable. For two professors, the 2006 exams seemed to exhibit no changes. For the other five professors, the 2006 exams exhibited noticeable improvement. But the 2005 exams appeared to be satisfactory to begin with.

Item Analysis Characteristics

Item Difficulty – number of very difficult items – In general, the items should not be too difficult. If less that 50% of possible points for an item were awarded, the item was judged to be too difficult. This threshold (50%) is not inappropriate and was used consistently to evaluate the exams and item analyses submitted by the professors. But the professors were informed that they should determine their own threshold, one that is meaningful to them and their exams – that there is no specific value that should be used for judging items in all situations.

> **Evaluation** – Some professors' 2005 exams contained a small number of problems, and these problems had generally high (easy) difficulty indices. All the analyses for the 2006 exam analyzed several more items. It appeared that more items were flagged as being too difficult (difficulty index less than 50%) than would normally be desired. New item types were being used for the first time by most of the professors and they are still learning how to use item analysis data to improve item performance for future administrations.

Item Discrimination – number of poorly discriminating items – In general, the items should discriminate between students proficient in the content and students who are less proficient. Items were flagged if the discrimination index was less than 0.15. This threshold in not completely arbitrary; however, as with the difficulty index, professors were counseled to choose a threshold that was meaningful and appropriate for their context. Professors were also informed, however, that an item should not have a negative discrimination index.

> **Evaluation** – For the 2006 exams, there were probably more poorly discriminating and negative discriminating items than would be desired. As indicated above, however, new item types were being used for the first time by most of the professors and they are still learning how to use item analysis data to improve item performance for future administrations.

Table B.6.1: 2005 vs. 2006 Test and Test Analysis Comparisons – Ibrahim Abdel-Motaleb

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	
Based on Table of Specifications	No	Yes	No	
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	OK. Test is only one item, 3 parts, 20 pts.	Very good! 33 Items.	Take home exam. One item, 3 parts, 50 pts.	
Overall Instructions - clear, unambiguous	Not really there. Only one item.	Not much there.	Instructions may be satisfactory. But pt values for items & overall test not specified.	
Instructions for Item Subsets - clear, unambiguous	NA	Yes. Some for matching and others.	NA	
Number of short, discrete items vs longer items	One long item - 20 pts.	Test contains mostly short, discrete items rather than a single long item.	One long item, 3 parts, 50 pts.	
Number of objectively scored vs subjectively scored items	Item is subjectively scored. No scoring criteria provided to students.	Several MC items (objectively scored) and short answer items (subjectively scored).	Subjectively scored. No scoring criteria provided.	
Item Quality - clear, direct, well written, no clues	Appears OK.	Appears OK.	Appears OK.	
Item Analysis Comparisons	One item, 3 parts, 20 pts.	33 items but only 20 in item analysis (?)	One item, 3 parts, 50 pts	
Item Difficulty - number of very difficult items	diff - 67%, the 3 parts not analyzed separately.	Diff: 16 items > 50% 4 items < 50%	Lowest diff = 72%. Overall test average = 77%	
Item Discrimination - number of poorly discriminating items	Can't compute since analyzed as one item, not for three parts.	Disc: 2 items 0.0-.15 1 item negative.	Lowest disc = .69. But high disc expected since only 3 parts.	

Table B.6.2: 2005 vs. 2006 Test and Test Analysis Comparisons – Abul Azad

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Generally good. Tests called First In-course Exam and Second In-course Exam. Total of 18 items.	About the same as F05; called Midterm. Total of 12 items.	Generally good. Only 8 items.	Similar to F05. 7 items (last item mislabeled as #8) 10 parts: 1a, 1b, 1c, etc.
Overall Instructions - clear, unambiguous	No overall test instructions.	No overall test instructions.	No overall test instructions.	No overall test instructions.
Instructions for Item Subsets - clear, unambiguous	NA	NA	NA	NA
Number of short, discrete items vs longer items	Combination of short-answer and longer-answer items. But items have multiple parts (1a, 1b, 1c, etc.	Fewer short- and long-answer items. Five MC items.	Most items appear to be longer, problem-type; remainder are short-answer. Some with multiple parts (1a, 1b, 1c).	All items are short- or long-answer type
Number of objectively scored vs subjectively scored items	All items appear subjectively scored.	Five of the twelve items are objectively scored.	All are subjectively scored.	All are subjectively scored.
Item Quality - clear, direct, well written, no clues	Items appear clear and direct.	Items appear clear and direct.	Items appear clear and direct.	Items appear clear and direct.
Item Analysis Comparisons	First 2 tests - 18 items = 200 pts; 12 items & 6 items	12 items = 100 pts.	8 items - 100 pts.	10 items/parts analyzed 100 pts.
Item Difficulty - number of very difficult items	14 of 18 items analyzed. All items were very easy: smallest diff = 72%.	1 diff = 20%	Very easy - smallest diff = 70%.	Lowest diff = 54% Others 61%-81%
Item Discrimination - number of poorly discriminating items	3 items had negative discrimination indices - partly because they were so easy and high scorers got them wrong.	4 items disc in 0.0-.15. 1 item negative disc.	2 items with disc <.10 No negative discriminators.	Lowest disc = .44 Others .71-.94

Table B.6.3: 2005 vs. 2006 Test and Test Analysis Comparisons – Brianno Coller

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Not really a midterm; just quizzes #3, #4 and #5. 15 pts and 2 problems each quiz. Total 45 pts.	Great looking exam! 34 items, 36 pts. Pts. specified for each item.	Doesn't really have the formal appearance of an exam. 4 problems, 15 pts each = 60 pts.	Great looking exam! 33 items, 33 pts. Pts. specified for each item.
Overall Instructions - clear, unambiguous	NA	Great - Comprehensive	None	Good
Instructions for Item Subsets - clear, unambiguous	NA	Very clear	NA	Very clear
Number of short, discrete items vs longer items	4 short-answer problems, 2 MC	All are short, discrete items	4 long problems.	All are short, discrete items
Number of objectively scored vs subjectively scored items	Only 2 items objectively scored.	All are objectively scored	All subjectively scored.	All are objectively scored
Item Quality - clear, direct, well written, no clues	OK	Very good	OK	Very good
Item Analysis Comparisons	Each quiz analyzed separately - not combined, 2 problems each.	34 items analyzed	4 problems analyzed	33 items analyzed
Item Difficulty - number of very difficult items	1 (of 6) diff <50% Quiz means are 61%, 52% and 42%	14 items diff < 50% Test mean = 55%	1 problem diff =50% Test mean = 58%	9 items diff < 50% Test mean = 59%
Item Discrimination - number of poorly discriminating items	Al 6 disc >.56	2 items disc 0.0-.15	All 4 disc >.58	3 items disc 0.0-.15 1 item disc negative

Table B.6.4: 2005 vs. 2006 Test and Test Analysis Comparisons – Abhijit Gupta

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Not much here. 3 problems. Slightly difficult to read. Poor photocopy?	A much better-looking exam than F05.	Could be better. Only 4 items. Poor photocopy.	Much improved appearance over F05.
Overall Instructions - clear, unambiguous	OK	Good. Includes pt. values for each item.	OK	Good, with pt values for each item.
Instructions for Item Subsets - clear, unambiguous	NA	Yes, good.	NA	Very good!
Number of short, discrete items vs longer items	All 3 items are long problem type.	All but 3 items are MC, TF. 41 total items.	All 4 are long problem type.	All but 4 items are MC, TF. 30 total items.
Number of objectively scored vs subjectively scored items	All subjectively scored.	All but 3 are objectively scored.	All subjectively scored.	26 items are objectively scored.
Item Quality - clear, direct, well written, no clues	Probably OK.	Very good.	OK	Very good!
Item Analysis Comparisons	3 items	41 items analyzed	4 items	30 items analyzed
Item Difficulty - number of very difficult items	Lowest diff = 53% Test mean = 67%	22 items with diff <50%. Test mean = 43%. Hard test!	Lowest diff=44% Test mean = 67%	7 items with diff <50% Test mean = 60% Not as hard as midterm.
Item Discrimination - number of poorly discriminating items	All disc good (>.50) Expected, with only 3 items.	8 items disc 0.0-.15 3 items negative disc	1 item disc =.17, others >.60	2 items disc 0.0-.15 3 items negative disc.

Table B.6.5: 2005 vs. 2006 Test and Test Analysis Comparisons – Reinaldo Moraga

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	OK Take home? Only 2 problems, 100 pts.	Great looking exam. 25 items, 100 pts.	OK 6 problems. 5 from textbook, 100 pts. Take home?	Part 1: 3 long problems from text = 100 pts. Part 2: Great looking exam. 25 items, 25 pts.
Overall Instructions - clear, unambiguous	OK	Good. More comprehensive	OK	Good for part 2
Instructions for Item Subsets - clear, unambiguous	NA	NA	NA	NA
Number of short, discrete items vs longer items	Both are long problems.	All items are short, discrete.	All are long problems.	25 items in part 2 are short, discrete.
Number of objectively scored vs subjectively scored items	Subjectively scored.	All are MC items.	Subjectively scored.	3 in part 1 are subjectively scored. 25 in part 2 are all MC.
Item Quality - clear, direct, well written, no clues	OK	Appears clear and direct.	OK	Good.
Item Analysis Comparisons	2 items analyzed	25 items analyzed	6 items analyzed	28 items analyzed
Item Difficulty - number of very difficult items	Both diff around 48%	7 items diff < 50% Test mean = 55% (Hard test)	All diff > 65%	9 items diff < 50% Test mean = 60%
Item Discrimination - number of poorly discriminating items	Both disc around .84	1 item disc 0.0-.15 (a very easy item) 1 item negative disc.	All disc > .46	4 items disc 0.0-.15 6 items disc negative

Table B.6.6: 2005 vs. 2006 Test and Test Analysis Comparisons – Regina Rahn

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Good 5 items with multiple parts. Total of 13 items/parts.	Great 30 items, 100 pts.	Good 6 items with multiple parts. (Take home?) Total of 19 items/parts	Good. 17 items, 105 pts.
Overall Instructions - clear, unambiguous	No overall test instructions	No overall test instructions	No overall test instructions	No overall test instructions
Instructions for Item Subsets - clear, unambiguous	Good	Good	Good	Good. 17 items, 105 pts.
Number of short, discrete items vs longer items	Most are problem-type. Some may be short-answer.	5 short answer 25 MC, TF, Matching	Most are problem-type. Some may be short-answer.	Most are short answer, remainder are longer answer.
Number of objectively scored vs subjectively scored items	All are subjectively scored.	5 subjectively scored 25 objectively scored	All are subjectively scored.	All are subjectively scored.
Item Quality - clear, direct, well written, no clues	Good	Good	Good	Good
Item Analysis Comparisons	13 items/parts analyzed	30 items analyzed	6 items analyzed- not by parts.	17 items analyzed
Item Difficulty - number of very difficult items	2 items diff <50% Test mean = 70%	3 items diff < 50% Test mean = 78%	All diff >73% Test mean = 82%	All items diff > 50% Test mean = 78%
Item Discrimination - number of poorly discriminating items	1 disc < .15 (=.07)	5 items disc 0.0-.15 2 items disc negative	1 disc <.15 (=.06) (1 high scorer did poorly on this item.)	1 item disc 0.0-.15 3 items disc negative

Table B.6.7: 2005 vs. 2006 Test and Test Analysis Comparisons – Robert Tatara

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Courier font. 25 items = 100 pts.	Bigger, more attractive font. Better overall appearance. 30 items = 30 pts.	Courier font. Layout and appearance OK. 35 items = 100 pts.	Better overall appearance. Better font
Overall Instructions - clear, unambiguous	Generally OK	Much better, clearer, more complete.	OK	Much better, clearer, more complete.
Instructions for Item Subsets - clear, unambiguous	NA	NA	NA	NA
Number of short, discrete items vs longer items	Some items are longer, problem type. Some are short answer.	No long problem-type. Fewer short answer, More are MC, TF, matching.	Several short-answer. Some longer problem-type. Not quite half are MC, TF, etc.	No long problem-type. Fewer short answer, More are MC, TF, matching.
Number of objectively scored vs subjectively scored items	Most are subjectively scored. Small number are objectively scored	Most are objectively scored - MC, TF, matching. Very few are short answer, subjectively scored.	19 subjectively scored. 16 objectively scored - MC, TF, etc.	Most are objectively scored - MC, TF, matching. Very few are short answer, subjectively scored.
Item Quality - clear, direct, well written, no clues	Perhaps some slight ambiguities -- but mostly clear and direct.	Appears clear and direct	Generally good.	Appears clear and direct
Item Analysis Comparisons	25 items analyzed	30 items analyzed	35 items analyzed	50 items analyzed
Item Difficulty - number of very difficult items	7 items (39%) diff < 50% Test mean = 66%	9 items (43%) diff < 50% Test mean 62%	4 items (13%) diff < 50% Test mean 74%	10 items (20%) diff < 50% Test mean 72%
Item Discrimination - number of poorly discriminating items	1 item disc negative	5 items disc 0.0-.15 4 items disc negative	10 items disc 0.0-.15 2 items disc negative	8 items disc 0.0-.15 4 items disc negative

ABET/ NAIT AND STUDENT LEARNING OUTCOMES SUMMARY

(See Reports in B.7.a.1 and 2; also, Professor Examples in B.7.b.1-5; also Portfolio Section A.5

Jule Dee Scarborough, Ph.D.

Upon completing the overall course analysis, teaching models and styles analyses, the student learning style analyses, and the analyses for achieving the levels of Bloom's Taxonomy and Dale's Cone of Learning, the professors engaged on a new interactive path between continuing to analyze aspects of the 2005 course and beginning the redevelopment of the 2006 course for the experimental research semester.

Process for Developing the 2006 Course Outcomes

During the Student Learning Outcomes program component, the faculty members reconsidered their course from the student learning outcomes perspective. They each determined the ABET or NAIT standards or outcomes that were important for their courses and redeveloped student learning outcomes at the primary, second, and third levels of breakout. Once the outcomes were developed and written appropriately as outcomes oriented statements that were measurable and active, they put them into a chart format. In preparation for the chart, most of them first developed an outline-like document or "list." Not all professors were proficient at the American or English concept of "outlining" showing levels of content breakout. Some opted for a list approach to this activity. For the most part, the list worked to serve our needs, which was to reveal the complexity of the primary outcomes and break them out into second and third level outcomes so the professors would better understand the complexity of the content in the course. This process also served to reveal the embedded general education knowledge and skills expected of students (e.g. mathematics, science, and communications). And even though the program leader had already prepared the chart(such that the ABET and NAIT standards or outcomes revealed the embedded NIU general education goals written as outcomes), this was an important aspect of the redevelopment of the 2005 course outcomes. The process led the professors into a deeper understanding of the embedded content, whether second and third level engineering and technology knowledge and skills or general education, and they became much more aware of what they were expecting of students and trying to achieve with student learning. We accomplished this through a variety of processes: outlining, lists, matching, analysis, and mapping connections. The charts worked well to assist in the process and organize the professors' redevelopment of the 2005 course outcomes.

Once the student learning outcomes were developed and connected to the national standards or outcomes, ABET or NAIT, and the embedded general education knowledge and skills were identified, the professors analyzed their new student learning outcomes to determine which of Bloom's <u>Knowledge</u> Dimensions were represented by the course content (e.g. factual, conceptual, procedural, or meta-cognitive). They then analyzed the new outcomes to determine or confirm that the outcomes were written to achieve more of the upper levels of Bloom's <u>Cognitive</u> Process Dimension, using either the traditional or revised version (e.g., traditional: knowledge, comprehension, application, analysis, synthesis, and evaluate; revised: remember, understand, apply, analyze, evaluate, and

create). Finally, the professors analyzed the outcomes for level of active versus passive learning on Dale's Cone.

Performance

Transitioning from analysis of the 2005 courses to their redevelopment, we will now speak in terms of the development of the 2006 version of their 2005 courses. The professors performed extremely well in the development of the 2006 courses and the student learning outcomes that define the courses. The learning outcomes statements were expressed more appropriately with active verbs and as measurable outcomes and were more specific. The terminology served to more clearly present what was to be learned by the students, and the learning statements were more coherent. With the breakout of the primary statements into the second and third levels, it became much easier to understand what was to be accomplished in the courses and by students. Furthermore, the overt identification and mapping of the embedded general education outcomes clearly revealed the expectations related to the underlying mathematics, science, and communication foundations of the engineering and technology knowledge and skill content. Using Bloom's Knowledge and Cognitive models served to reveal and assure the professors that the outcomes statements were capable of formally achieving the upper cognitive levels and inherent higher levels of critical thinking. Identifying the content by Bloom's Knowledge Dimensions served to confirm that the content was addressing more than factual knowledge (i.e., lower levels of the Cognitive Process Dimension). They tried to more formally show that the four (facts, conceptual, procedural, and metacognitive knowledge) were represented in the student learning outcomes. The more knowledge dimensions represented in course content, the greater the possibilities for learning to achieve the higher levels of the cognitive process dimensions. This one aspect, however, was not accomplished as deeply as we would have preferred. The analysis related to Bloom's Knowledge Dimension needed more time and focus. However, most of the professors understood how it could help them analyze their content and improve its coverage if they included content from more of the knowledge dimensions, realizing that if they are addressing each of Bloom's Knowledge Dimensions, they are more likely to achieve the higher levels of Bloom's Cognitive Process Dimension more often. They became aware of the potential of the knowledge dimension, but during our process did not use it to its fullest power to improve the content of their courses. However, their course contents did reflect knowledge from across Bloom's knowledge dimensions; but it was documented as completely as possible. Finally, the professors determined whether each outcome was active, passive, or intermediately active on Dale's Cone of Learning. This assisted them to focus on the quality of learning through purposeful constructivism, where the burden of learning to build knowledge and skills through accomplishing real world tasks is on the student, going beyond the more abstract memorization and limited comprehension levels to being able to use knowledge, manipulate it, extend it through problem based learning and across different learning contexts. The professors tried to build scaffolding into the learning process to increase depth and understanding through increased ability to use knowledge and skills being learned while also engaged in learning.

Results

Overall, the 2006 courses have greatly improved student learning outcomes that will engage students in learning more actively at the upper levels of Bloom's Cognitive Process Dimension. The professors are also cognizant of Bloom's Knowledge Dimensions and that they should strive to address the four types of knowledge with particular purpose. They did check that the knowledge and skills, etc. represented in the student learning outcomes crossed the four knowledge dimensions. However, they could have used more time to focus on this aspect of our program. The professors benefited from using Dale's Cone to gauge the quality of active learning. Ultimately, Bloom and Dale's models have become informal and formal metrics for continuous improvement of the courses, teaching, assessments, and student learning. The professors have a much deeper understanding of what outcomes statements should achieve, their connection to the ABET and NAIT standards and outcomes, their relationship to the embedded general education goals, and that they are written to lead students to "knowing about," "knowing," or "being able to "do" or perform." They also better understand what active or engaged learning means and that if they are to lead students to "using" knowledge and skills, then active learning involves creating a different type of learning environment: one that is inquiry and discovery driven and one that goes beyond "problem solving" to problem based learning where students have the opportunity to perform real world tasks using their knowledge and skills and where expectations for performance are clearly understood by professors and students because there are clear and well defined performance standards and criteria. They understand how to use the Bloom's models to analyze and develop their courses. Of great importance is that professors now see the embedded general education outcomes as more than prerequisites or foundations for learning the engineering and technology content. The professors now better understand that the engineering and technology learning context and content continues, extends, deepens, and expands the learning of general education knowledge and skills and, ultimately, that they are responsible for continuing the learning of mathematics, science, and communication at higher levels in the engineering and technology contexts. That is a very different viewpoint and understanding. The following data tables support that conclusion.

In summary, the outcomes can continue to improve and be refined, but the learning, demonstrated by the professors through their 2005 outcomes analyses and newly developed 2006 outcomes, which were greatly improved, revealed their deeper understanding and ability to make course content decisions and to use a stronger theoretical basis for making those decisions. They have the knowledge and skill to continue this process from this point forward, as they have clearly demonstrated their significant gain in knowledge, skills, and ability regarding the development of student learning outcomes. The Outcomes program component led to the Student Assessment program component.

See Copy of Section B.5.b GAPS Analysis (Discussion of Student Learning Outcomes) Below

GAPS ANALYSIS SUMMARY (FALL 2005 AND FALL 2006)

Jule Dee Scarborough, Ph.D.

Student Learning Statements (Outcomes)

In the initial analysis of the Fall 2005 courses – where we began, professors used their existing course syllabi. Although as a college, we had improved our student learning statements during the accreditation process, they remained rather unorganized and weak in content and appropriate expression. The learning statements were expressed in mixed modes across syllabi. Some learning statements were written as course objectives; others were written as student learning objectives; yet others were written as more outcome-oriented statements. However, in generalizing, many and sometimes most of the student learning statement formats across syllabi were not active, clear, measurable, or clearly outcomes-oriented, where the professor and student could ascertain exactly what was expected and would be measured, and/or determine the culminating grade. Three professors expressed the learning statements in a way where students could see that there was a relationship between student learning outcomes and the ABET or NAIT outcomes, but if the ABET or NAIT outcomes were identified by a letter and not stated, then the relationship was not clear nor were students about to review the accreditation outcomes for their own information. Two professors expressed the statements more clearly, with written statements for both the national standards and the learning outcomes for the course. The other five professors did not show the national statements in narrative but rather identified them by letter or number, regarding the level of coverage and depth of relationship. This had little meaning for students and did not make it easy for the professors to clearly be assured of direct links and relationships. Generally, the statements did link to the ABET or NAIT standards or outcomes, but often not clearly or strongly. It would have been difficult to determine a direct link, especially in light of the student learning assessments being used for the 2005 course. Therefore, we examined the 2005 syllabi and course content related to the standards as well as we could, with the understanding that the student learning outcomes to be redeveloped would better and more clearly and directly link to the national standards and assessments – a two-way link revealing the critical knowledge and skill connections.

Below are two charts that broadly identify the standards addressed in the Fall 2005 courses, according to the content and syllabus analysis by each professor of his/her course. The data are presented (in black) as collapsed across either all engineering professors or engineering technology professors as a broad viewpoint. The **Fall 2006** courses are presented in red, and although there are minor differences in the number of standards addressed, there is a great and very significant difference in the quality of the learning statements and their direct links to both the national standards and the learning assessments. The tables also reflect the number of learning outcomes for each standard by professor, **2005-2006** when possible. For the **2006** courses, the professors not only have improved wording and expression, but the knowledge and skill connections are much stronger. In addition, the outcome statements are improved because they are broken out into primary, second, and third level statements. The quality is improved not only because of better wording, but also because they now better understand the difference between complex statements, where there is a cluster of outcomes inherent to a single

primary outcome statement. Thus the course content or the knowledge and skills to be taught became more obvious in the inherent breakouts of second and sometimes third level outcomes. This provided insight and assisted the professors in understanding what underlying or inherent knowledge and skills were required for a complex cluster of difficult primary learning outcomes – in other words, the knowledge and skills inherent to a single complex primary outcome. Therefore, readers may be amazed at the number of changes that resulted.

Usually, the primary statements would be used on syllabi or other reporting documents, but the analysis and breakout of second or third level learning statements provided a great learning experience for professors and led them to design and then engage students in more intentional, thoughtful, and higher quality learning experiences. This analysis and process can lead to more astute teaching and student learning, student assessments, instructional choices, learning process decisions, and more. Remember, each course is not required to address every national standard or outcome, but instead the standards or outcomes of focus selected should be addressed well. It is important that the professors understand individual course versus program requirements, that there is a cumulative effect across courses for the entire program and that the overall program is required to address all national standards or outcomes, not any single course; therefore, many standards will be addressed across multiple courses. However, particular standards may be addressed in only one or two courses across the program, depending on content, depth, program level, (e.g., introductory or capstone course). Professors sometimes mistakenly strive to address all or too many outcomes; thus the course content can become weak or superficial. Finally, when identifying the objectives or outcomes listed below, an * is used where one objective or outcome covers more than one ABET outcome or NAIT standard or where there is a greater total of "1s" than the total in the number in parentheses (4). The determining factor is the level of coverage of content.

Regarding outcomes, it is important to note that the professors analyzed the engineering or technology course content for embedded NIU General Education Goals. This analysis led them to more deeply understand why students fail to perform well in their courses if they do not come to the course with the appropriate general education knowledge and skills that are the underlying foundation for the engineering and technology content. The program leader revealed the strong relationships between NIU General Education Goals (outcomes) and the ABET and NAIT standards or outcomes by aligning and inserting them into a worksheet. That made it much easier and more efficient for the professors to see the direct relationships, to consider the importance of acknowledging the embedded general education goals/outcomes as part of their course content, and to realize that even though they are teaching engineering or technology courses, they are actually concurrently continuing, extending, expanding, and deepening the learning of general education content in the context of engineering and technology. This was extremely important. Our professors intuitively knew this but had never "studied" the connections, mapped the connections, or included the general educational goals aligned beside their engineering or technology outcomes. They had also never thought of themselves as continuing the learning of the general education knowledge and skills in engineering and technology content. They considered the general education math, science, and

communication knowledge and skills as prerequisites and only dealt with them when students did not have the knowledge or skills needed to perform on the engineering and technology content. Now the professors understand that they actually continue the learning of the mathematics, science, communication, etc. content in the engineering and technology context. The chart below reflects the 2005 course in black and the changes for the **2006** course in red. The professors improved the outcomes and connections and are committed to greater depth of change for the future. This was a very successful program component, resulting in significant learning and change.

Assumptions

Beware of assumptions when scanning the chart below and noting that one or more course outcome numbers did not seem to change. For example, one professor's number of outcomes did not change from 2005-2006; however, the quality of the outcomes for 2006 was very significantly different and improved. Also that professor's four primary outcomes were broken out into second and third level outcomes. Again, for example, one primary outcome inherently encompassed five secondary outcomes, with each of those broken out into a third level. Thus, the quality in content, linkages, and assessments was dramatically different and greatly improved for most of the courses.

Table B.7.1: Standards ABET-Engineering Outcomes (Fall 2005 and Fall 2006 courses) (5 engineering professors)

a. apply math, science, engineering	b. design/ conduct experiments; analyze, interpret data	c. design system, component, process-given constraints, etc.	d. function on inter-disciplinary teams	e. identify, formulate, solve engineering problems	f. understand professional, ethical responsibility	g. ability to communicate effectively	h. understand impact eng. Solutions on global, economic, environment, society	i. recognition of need for, and ability to engage in life-long learning	j. knowledge in contemporary issues	k. ability to use techniques, skills, and modern engineering tools
Fall 2005 and Fall 2006 Courses – ABET Outcomes										
5 + 5+	2+ 1partial (no DOE) 1 NR 1 c 2+	4 + 1+partial (could do lots more) 1 c 4+	1+ 1 NR 3 c 2+	4+ 1c 5+	1+ 1+ (written reports only) 1 NR 2c None	1+ 1 3c 3+	1+ 1 NR 2c 1c (minor) 1+	2+ 1+ (to small effect) 2c 2+	4+ 1c 4+	4+ 1+ (students don't use unless asked to) 5+
(6-11) 1 - 4	1 - 1	1 - 2	1 - 1	* - 8		1 - 1	1 - none	* - none	* - 2	* - 3
(3/6--5) 1-5		1 - 1		1 - 5				* - 1	* - 1	1 - 1
(4-4) 1 - 1	* -none	1 - none	* - none	1 - 1	* - none	* - 1	*		*	1 - 1
(4-5) 1 - 5		1 - 5	3	1 - 5	* - none	1 - 3	* - none	* - 1	* - 1	1 - 2
(4-5) 1 - 2		1 - 1		1 - 1	* - none				1 - 1	1 - 1

Legend: + = yes-okay; c = need to consider; other notes

Table B.7.2: Standards ABET/TAC/NAIT-Engineering Technology & Industrial Technology
(2 engineering technology/technology professors) (Fall 2005 and Fall 2006 courses)

a. mastery of knowledge, techniques, skills, modern tools	b. ability to apply current knowledge; adapt to emerging applications of math, science, technology	c. ability to conduct, analyze, interpret experi-ments; apply experiment al results to improve processes	d. ability to apply creativity in design of systems, components, processes	e. ability to function effectively on teams	f. ability to identify, analyze, solve technical problems	g. ability to commu-nicate effectively writing	h. ability to com-municate effectively orally	i. recognize need for, ability to engage in lifelong learning	j. ability to under-stand profes-sional, ethical, social responsi bilities	k. respect for diversity; know-ledge of contempor ary profession-al, societal, global issues	l. commit to quality, timeliness, continuous improve-ment	m. ability to program computers and/or use computer application s effectively	n. ability to use modern labor-atory tech-niques, skills, equip-ment effect-tively	o. ability to manage projects effect-tively	p. ability to design, mani-pulate, manage industri al systems q. ability to manage or lead person-nel effect-tively
Fall 2005 and Fall 2006 Courses – ABET/TAC/NAIT Outcomes															
2+ 2+	2+ 2+	1+ 1c 2+	1+ 1c 2+	1+ 1c None	2+ 2+	1+ 1c 2+	1+ 1c None	1+ 1c 2+	1+ 1c 1+ ? not sure	1+ 1c 1+	2+ 1+	2c 1+	1+ 1c 1+	1+ 1c None	p. 1 no re-sponse 1c None q. 1no re-sponse 1c None
(5-6) 1-6 (6-19) 1-10	1 - 5 1 - 5	1- 1 * - 5	* - 1 * - 3		1 - 4 1 - 6	6 1		* - 4 4	2 1-one	1 1	2 *-none	1	1 – 1	 *-none	p. * -NR NR-NR q. *-NR NR-NR

Legend: + = yes-okay; c = need to consider; other notes

Table B.7.3: NIU General Education Goals (Fall 2005 and Fall 2006) (7 professors across engineering and technology)

Writing	Speaking	Listening	Quantitative Reasoning	Use of Resources-Technology	Historical Development Of Culture	Significance of Arts	Cultural Traditions Philosophical Ideas	Methods in Science Methods in Social Science	Interrelatedness Across Disciplines	Social Responsibility Citizenship
C C+ Earlier it was only lab reports. In fall 06, they had to write reports for three PA tasks.	C C+ Presentation of PA tasks	+ + Listen to guest speaker, professor, fellow students during PA task presentations	+ C+ Homework, exams, PA tasks – all involved quantitative reasoning	+ + In addition to labs that required using many resources, had to use outside resources for PA tasks.	NR NA	NR NA	NR NA	NR NA	NR C May consider more interaction with EE for signal processing	NR C+ Discussed issues such as energy conservation, noise, pollution, ethics, etc.
C+ Did consider and add, still needs improvement; will keep working on it	C	?	C+ Strong, but could be better	+ I'm quite pleased	NA	NA	C-	C+	C	C
Ok + Project, exams, homework, using MS Word	C + Oral presentations with PowerPoint	C C-	Ok + Material requires this	Ok + Software and computer to solve problems	NR NA	NR NA	NR NA	C NA	Ok, C+ Examples, exercises with topics from other disciplines	C C-
+ + PAs and homework	+ + Pas and discussion sessions	+ + Lectures, case studies, discussion sessions	+ + Problem solutions, homework, midterm and final exams	+ + PAs and homework	C NA	C NA	C NA	+ + Problem solutions, homework, midterm, final exams, and PAs	+ + Case studies and PAs	+ C-
C - + well addressed through PA reports	+ NA- possible to include for future course	C + lectures	+ + addressed in project design decisions	C + well addressed through project design decisions	NR NA	C + addressed through project design	NR - NA	C + well addressed through project design	C C+ to some extend when making design decisions	C C- possible to include for future courses
+ + Performance Tasks	+ + Group learning and interactions	+ + Group interactions	+ + Performance tasks, lab demonstrations	C NA	+ C+	C + Lectures	+ C+	+ NA?	C C+	+ C+
C +	C C-	C C-	+ N+	+ +	+ NR	C NA	C NA	+ NA	C NA	C N\A

Legend: + addressed well; NA-does not really apply in professor's opinion; C- do not do it, but still need to consider adding it in as professor continues to make changes; C+ did consider and add in; still needs improvement and professor will keep working to improve or add;

Table B.7.a.1.1: Engineering Student Learning Outcomes & Bloom & Dale (Fall 2005 and Fall 2006)

The professors analyzed their student learning outcomes against Bloom's Learning Dimensions and Dale's Cone of learning. The analysis of the 2005 course is presented in black below and also as a composite, number of outcomes achieving what level on Bloom's and Dale's models. The 2006 course analysis, however, is presented in red. Dale's levels are presented by number of outcome and level of the Cone. For Bloom, each outcome is listed at the level achieved. ***(1), (2), (3), (4), (7) ABET Engineering courses.**

Student Learning Outcomes & Bloom & Dale (Fall 2005 and Fall 2006) (7 professors across engineering and technology)

# Outcomes: 05 reported as composite 06 reported- specific outcome	Dale's Cone Levels : P A A+	Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create	Critical Thinking Level: L M H
*(1) 6 outcomes composite 1-11 numbers 1-11	NR 1-11 (8-10) A+	1+, 5NR	2+, 4NR	2+, 4NR	1c, 5NR 1, 3, 7. 8. 9	1+, 5NR 2, 5, 6, 7. 10, 11	6NR 1, 4	2Lm 3M, 1H
*(2) 3/6 5	3P, 1A 2A- 1-5 (10) A+	6+	6+	3+, 3c	5c, 1NR	6c	6c 1-3/6	2L, 2L+, 1L/M, 1M; 2Mc
*(3) 2 2	2 PA-C 1-2 (8-10) A+	2 +c	2 +c	2+c	2 +c	2 +c	2c 1, 2	2Mc
* (4) 4 5	2A, 2A+ NR	4+ NR	4+ NR	4+ NR	4+ NR	1c, 1+-, 2+ NR	4c NR	2M, 2H
*(5) 5 19	2P, 2A, 1A+ 1 (6); 2-3 (9) 4 (6) 5-19 (9-10)A+	2+, 3NR NR	2NR, 3+ NR	2NR, 3+ NR	NR NR	NR NR	NR NR	3M
*(6) 6 6	4P, 2A 3 (2) 4 (1,3,5) 8-9 (1) 8 (1)	2+, 4c	3+, 3c 1, 2, 3, 5	5+, 1c	4+, 2c	5+, 1c 4	4c, 2+ 6	3L, 2M, 1H
*(7) 4 4	1P, 1P-A, 2A-P 1-4 (1-10)	4+	4+	1+c, 3+	1c, 1c+, 2+ 1	2c, 2+ 2	2c, 2+	2c, 2c+ 3, 4

Bloom (1956); Anderson & Krathwohl (2001); Legend for Blooms levels: NR = no response; number + = number of outcomes at that level; +c = okay, but still need to consider; c=need to consider achieving; c+=some positive accomplishment, but still needs work **(e.g., outcome number reported by each Bloom level)**

Dale (1969): Legend for Dale's levels: 9-10 =active learning-doing level; 8=active learning-participating; 3-7=visual receiving/passive; 2-1=verbal receiving-passive, **(e.g., outcome number - level)**

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
A. Apply knowledge of math, science, engineering **NIU Gen Ed Goals -** ***Students:*** ***a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
B. Design and conduct experiments; analyze and interpret data **NIU Gen Ed Goals -** ***Students:*** ***a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
C. Design a system, component, process to meet desired needs within realistic constraints (e.g., economic, environmental, social, political, ethical, health, safety, manufacturability, & sustainability). **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
D. Function on multi-disciplinary teams. **NIU Gen Ed Goals-** **Students:** ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
E. Identify, formulate, and solve engineering. problems **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
F. Understand professional and ethical responsibility **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
G. Communicate effectively **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
H. understand impact of engineering solutions in a global economic, environmental, societal context **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
I. Recognize the need for, and have capability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv.** ***are able to access and use various information sources.*** ***Internet, text, and field case.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
J. knowledge of contemporary issues **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
K. use techniques, skills, and modern engineering tools necessary for engineering practice	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

Note: Additional educational outcomes -NIU General Education Goals - articulated by the overall program

Table B.7.a.2.1: Engineering Technology and Technology Student Learning Outcomes & Bloom & Dale (Fall 2005 and Fall 2006)

The professors analyzed their student learning outcomes against Bloom's Learning Dimensions and Dale's Cone of Learning. The analysis of the 2005 course is presented in black below and also as a composite, number of outcomes achieving what level on Bloom's and Dale's models. The 2006 course analysis, however, is presented in red. Dale's levels are presented by number of outcome and level of the Cone. For Bloom, each outcome is listed at the level achieved.
*** (5) and (6) ABET/TAC/NAIT courses.**

Student Learning Outcomes & Bloom & Dale (Fall 2005 and Fall 2006) (7 professors across engineering and technology)

# Outcomes: 05 reported as composite 06 reported- specific outcome	Dale's Cone Levels : P AA+	Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create	Critical Thinking Level: L M H
(1) 6 outcomes composite 1-11 numbers 1-11	NR 1-11 (8-10) A+	1+, 5NR	2+, 4NR	2+, 4NR	1c, 5NR 1, 3, 7. 8. 9	1+, 5NR 2, 5, 6, 7. 10, 11	6NR 1, 4	2Lm 3M, 1H
(2) 3/6 5	3P, 1A 2A- 1-5 (10) A+	6+	6+	3+, 3c	5c, 1NR	6c	6c 1-3/6	2L, 2L+, 1L/M, 1M; 2Mc
(3) 2 2	2 PA-C 1-2 (8-10) A+	2 +c	2 +c	2+c	2 +c	2 +c	2c 1, 2	2Mc
(4) 4 5	2A, 2A+ NR	4+ NR	4+ NR	4+ NR	4+ NR	1c, 1+-, 2+ NR	4c NR	2M, 2H
*(5) 5 19	2P, 2A, 1A+ 1 (6); 2-3 (9) 4 (6) 5-19 (9-10)A+	2+, 3NR NR	2NR, 3+ NR	2NR, 3+ NR	NR NR	NR NR	NR NR	3M
*(6) 6 6	4P, 2A 3 (2) 4 (1,3,5) 8-9 (1) 8 (1)	2+, 4c	3+, 3c 1, 2, 3, 5	5+, 1c	4+, 2c	5+, 1c 4	4c, 2+ 6	3L, 2M, 1H
(7) 4 4	1P, 1P-A, 2A-P 1-4 (1-10)	4+	4+	1+c, 3+	1c, 1c+, 2+ 1	2c, 2+ 2	2c, 2+	2c, 2c+ 3, 4

Bloom (1956); Anderson & Krathwohl (2001); Legend for Blooms levels: NR = no response; number + = number of outcomes at that level; +c = okay, but still need to consider; c=need to consider achieving; c+=some positive accomplishment, but still needs work **(e.g., outcome number reported by each Bloom level)** Dale (1969): Legend for Dale's levels: 9-10 =active learning-doing level; 8=active learning-participating; 3-7=visual receiving/passive; 2-1=verbal receiving-passive **(e.g., outcome number - level)**

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
A. Mastery of knowledge, techniques, skills, modern tools of disciplines.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
B. Apply current knowledge and adapt to emerging applications of math, science, engineering, and technology. **NIU Gen Ed Goals -** ***Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
C. Conduct, analyzes, and interprets experiments; apply experimental results to improve processes. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
D. Ability to apply creativity in the design of systems, components, or processes appropriate to program objectives. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
E. Function effectively on teams. **NIU Gen Ed Goals- Students:** ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
F. Identify, analyze, and solve **technical problems.** **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
G. Communicate effectively in writing. **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
H. Communicate effectively orally.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
NIU Gen Ed Goals - Students: ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.*** a***ii. communicate in a manner that unites theory, criticism, and practice in speaking & writing.***									
I. Recognize the need for, and an ability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv.** ***are able to access and use various information sources.*** ***Internet, text, and field case.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
J. Understand professional, ethical, and social responsibilities. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
K. Respect for diversity and a knowledge of contemporary professional, societal, and global issues. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
L. Commitment to quality, timeliness, and continuous improvement.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
M. Ability to program computers and/or utilize computer applications effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
N. Ability to use modern laboratory techniques, skills, and/or equipment effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
O. Ability to manage projects effectively. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
P. Ability to design, manipulate, and manage industrial systems. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
Q. Ability to manage or lead personnel effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

Addition: Additional educational outcomes -NIU General Education Goals - articulated by the overall program

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
A. Apply knowledge of math, science, engineering **NIU Gen Ed Goals -** ***Students:*** ***a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	✓ Factual Knowledge ✓ Conceptual Knowledge ✓ Procedural Knowledge ✓ Meta-Cognitive Knowledge	**A**	I. To learn to use a specific set of analytical tools for technical decision making under uncertainty.	★			★		
			A. Students will be able to construct/create a decision tree to aid in determining the best course of action for a given set of circumstances	★			★		
			1. To define the states of nature of the system, process, or situation	★		★			
			2. To develop the branch structure of the tree a. To identify decision nodes; what are the items the decision maker chooses b. To identify the chance nodes; the events that occur by chance with a given probability c. To draw the arcs, which define the sequences and relationships between nodes	★		★			
			3. To identify the outcomes a. To define the choices for a decision node b. To define the possible outcomes of a chance node, which are a set of mutually exclusive outcomes c. To define the "consequence," or the final outcome of a branch	★		★			
			4. To solve for the expected value of the decision tree (EV, EMV) a. To construct the joint, conditional, and marginal	★		★			

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
			probabilities						
			b. To calculate all branch probabilities of the tree	★		★			
			i. To apply Baye's Theorem						
			ii. To implement the inverse tree structure technique						
			5. To find and compare the expected value of both sample and perfect information (EVPI, EVSI)	★				★	
			a. To construct the decision trees to calculate EVPI and EVSI	★		★			
			b. To evaluate the relevance and importance of the values obtained for EVPI and EVSI to the decision process	★				★	
			B. Students will be able to construct the formulae for conditional likelihood ratios and to calculate the probabilities/ratios	★			★		
			1. To calculate the conditional likelihood ratio (CLR) associated with a particular observation	★		★			
			2. To calculate the CLR for multiple observations	★		★			
			3. To compare these results with Baye's Theorem	★			★		
			C. Students will be able to construct a single-attribute utility function	★			★		
			1. To propose a lottery that would be appropriate for evaluation of risk						
			2. To calculate the necessary						

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
			values from the lotteries needed for analysis a. To calculate the certainty equivalent b. To calculate the risk premium c. To calculate the selling price d. To calculate the buying price e. To calculate the insurance premium						
			3. To translate the lotteries into a mathematical function	★			★		
			4. To create a graphical interpretation of the function	★				★	
			5. To analyze and compare two lotteries at a time, to be used when a reference point is needed	★			★		
			D. Students will be able to develop and analyze fault trees	★			★		
			1. To describe the events of a tree for a given scenario a. To identify the top event b. To define primary and secondary failures and command faults c. To identify the sequence of events	★		★			
			2. To create the fault tree for a given scenario (such as the safety analysis of a system) using deductive analysis a. To define the "and" and "or" gates b. To implement the logic symbols into the tree	★				★	

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
			3. To develop and analyze dual fault trees a. To translate the meaning of a system failure into the reliability of the system E. Students will be able to construct a multi-attribute utility function 1. To construct a graphical model for the function 2. To develop a mathematical model for the function	★ ★		 ★		★	
B. Design and conduct experiments; analyze and interpret data **NIU Gen Ed Goals -** ***Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***			N/A						

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
C. Design a system, component, process to meet desired needs within realistic constraints, e.g. economic, environmental, social, political, ethical, health, safety, manufacturability, & sustainability. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	✓ Factual Knowledge ✓ Conceptual Knowledge ✓ Procedural Knowledge ✓ Meta-Cognitive Knowledge	**A**	III. To structure and solve complicated decision problems	★					★
			B. Students will be able to define a scenario to be analyzed with the decision analysis techniques 1. To research an area in which the tools can be applied, and to choose a problem for study 2. To define the scope for the problem chosen 3. To determine a set of objectives for the given problem	★					★
			C. Students will be able to formulate/design a possible solution approach to the given problem 1. To determine an appropriate solution technique to be applied to the problem from the set of available tools 2. To formulate the solution	★					★
			D. Students will be able to implement the solution techniques to obtain a first round solution 1. To solve the formulation	★					★
			E. Students will be able to analyze the solution found in order to assess the current state 1. To assess/analyze the value of the solution found (does it make sense numerically?) 2. To evaluate the significance of the solution (what does this mean for the decision maker?)	★			★		
			F. Students will be able to recommend a course of action based on the original solution 1. To establish if the decision maker is risk averse, risk prone,	★				★	

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
			or risk neutral 2. To recommend the path that the decision maker should embark upon, based on the results G. Students will be able to assess the usefulness of the solution and recommend any changes in the process 1. To evaluate if the current solution adequately answers the most important questions facing the decision maker 2. To analyze the solution for computational accuracy 3. To decide if the solution should be improved upon a. To conclude if factors (attributes) need to be added b. To conclude if factors (attributes) need to be removed c. To determine if the correct probabilities were utilized						

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
D. Function on multi-disciplinary teams. **NIU Gen Ed Goals- Students:** ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	✓ Factual Knowledge ✓ Conceptual Knowledge ✓ Procedural Knowledge ✓ Meta-Cognitive Knowledge	**A**	IV. To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario A. Students will explain results via a formal presentation B. Students will explain results via a formal written technical report						

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
E. Identify, formulate, and solve engineering. problems **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	✓ Factual Knowledge ✓ Conceptual Knowledge ✓ Procedural Knowledge ✓ Meta-Cognitive Knowledge	**A**	II. To apply analytic decision making techniques for technical decision making under uncertainty, and to analyze and evaluate the results. A. Students will be able to perform sensitivity analysis on a decision tree scenario 1. To construct a graph to interpret the results a. To plot the two dimensional plane for a single chance node sequence i. To interpret the graph b. To plot the plane for two sequential chance events (plot the pq plane) i. To interpret the graph 2. To determine the threshold probability levels a. To decide if the current solution is a good one and justify the decision b. To determine the salient factors (variables) in the decision being modeled by the current tree c. To make recommendations for improvements H. Students will be able to make inferences about a system based on the values of the conditional likelihood ratios 1. To determine the pass or fail rates allowed for a given set of specification limit 2. To determine probabilities of						

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
			occurrence for multi-variate systems based on the values of the CLR's						
			I. Students will be able to evaluate a given utility function	★				★	
			1. To analyze the degree of risk aversion from the utility function; risk prone, risk averse, risk neutral	★			★		
			2. To assess the process being modeled; is the model sufficient a. To determine if the model needs to have more attributes	★				★	
			3. To recommend any changes in the model a. To decide if more iterations are necessary for the lotteries b. To decide if any of the lotteries need to be referenced c. To determine if the utility function is consistent with the behavior of the decision maker	★				★	
			J. Students will be able to evaluate the scenarios modeled by a fault tree 1. To determine the reliability and failure probability relationships 2. To propagate the probabilities through the gates 3. To perform a qualitative evaluation a. To determine cut sets, as well as the minimal cut set	★				★	

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
			4. To perform a quantitative evaluation a. To determine cut sets, as well as the minimal cut set b. To develop the equivalent fault tree c. To obtain the numerical probability that a given cut set induces failure of the system 5. To implement the additive model for multi-attribute scenarios K. Students will be able to implement the additive model for multi-attribute utility theory 1. To assess a two-attribute utility function 2. To determine the weights of the functions (the k's)						

ABET Engineering Outcomes	**Bloom's Knowledge Dimension/**	**Dale's Cone Passive/Active**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
F. Understand professional and ethical responsibility **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***			N/A						
G. Communicate effectively **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	✓ Factual Knowledge ✓ Conceptual Knowledge ✓ Procedural Knowledge ✓ Meta-Cognitive Knowledge	**A**	V. To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario A. Students will explain results via a formal presentation B. Students will explain results via a formal written technical report						

ABET Engineering Outcomes	Bloom's Knowledge Dimension/	Dale's Cone Passive/Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
H. understand impact of engineering solutions in a global economic, environmental, societal context **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***			N/A						
I. Recognize the need for, and have capability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv. *are able to access and use various information sources. Internet, text, and field case.***	✓ Factual Knowledge ✓ Conceptual Knowledge ✓ Procedural Knowledge ✓ Meta-Cognitive Knowledge	**A**	V. To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario	★				★	
J. knowledge of contemporary issues **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	✓ Factual Knowledge ✓ Conceptual Knowledge ✓ Procedural Knowledge ✓ Meta-Cognitive Knowledge	**A**	IV. To identify and define any limitations of the models and techniques for rational decision-making.	★				★	

ABET Engineering Outcomes	**Bloom's Knowledge Dimension/**	**Dale's Cone Passive/Active**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
K. use techniques, skills, and modern engineering tools necessary for engineering practice	✓ Factual Knowledge ✓ Conceptual Knowledge ✓ Procedural Knowledge ✓ Meta-Cognitive Knowledge	**A**	IV. To identify and define any limitations of the models and techniques for rational decision-making. V. To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario						

Addition: Additional educational outcomes -NIU General Education Goals - articulated by the overall program

Table B.7.b.2: *Abul Azad* *May 15th 2006*

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone Passive Participating Active	Student Learning Objectives	Bloom's Cognitive Process Dimension Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
A. Mastery of knowledge, techniques, skills, modern tools of disciplines.	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	**Passive**	**1. To examine the components of a digital system.** a. To contrast between analog and digital signals b. To classify binary digits, logic levels, and digital waveforms c. To compare basic logic operations d. To categorize fixed function integrated circuits e. To interpret the operation of simple digital systems	 	 				
		Active and passive	**2. To examine the structures for various number systems.** a. To distinguish between various parts of number systems. b. To examine the counting in binary, octal, decimal, and octal.						
		Active and passive	**3. To distinguish the conversion methods for various number systems.** a. To convert between binary and decimal b. To convert between binary and hexadecimal c. To convert between binary and octal						
		Passive	**4. To perform different binary arithmetic operations: addition, subtraction, 1's complement, 2's complement, and signed numbers.** a. To examine the basic rules involving each of the operations. b. To use the rules to perform each of the operations.						
		Active and passive	**5. To examine the operation and use of various logic gates with different input patterns: AND, OR, and NOT, NAND, NOR, XOR and XNOR.** a. To develop the truth tables of various logic gates using established rules.						

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
			b. To use the truth tables to identify output pattern of a logic gate for a given set of input. c. To predict output logic levels for a pulse input pattern. d. To recommend the use of appropriate logic gate(s) for a given application.						
		Active and passive	**6. To analyze the properties of fixed-function logic integrated circuits (IC): Complementary Metal Oxide Semiconductor (CMOS) and Transistor-Transistor Logic (TTL).** a. To identify various supply voltage and power requirements for CMOS and TTL ICs. b. To analyze the generic numbering convention for CMOS and TTL ICs. c. To classify common logic gate ICs according to their standard identifier digit. d. To examine the logic gate configuration within an IC. e. To compare alternative logic symbols for representing logic gates while drawing a circuit diagram. f. To examine the voltage values for input output logic levels for CMOS and TTL ICs.						
		Active and passive	**8. To use Laws and Rules of Boolean algebra and DeMorgan's Theorems for manipulating Boolean expressions.** a. To use the commutative, associative, and distributive laws to manipulate Boolean expressions. b. To examine the use of Boolean rules while manipulating Boolean expressions. c. To use DeMorgan's Theorems for manipulating Boolean expressions. d. To adapt the Boolean laws, Boolean rules, and DeMorgan's Theorems while minimizing Boolean						

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
			expressions.						
		Active and passive	**9. To analyze digital logic circuits using Boolean algebra.** a. To develop a Boolean expression for a given logic circuit. b. To evaluate a Boolean expression and prepare a truth-table for the logic circuit. c. To demonstrate the use of Boolean algebra while minimizing Boolean expressions.		 	 			
		Active and passive	**12. To minimize logic expressions using Karnaugh map (K-map).** a. To develop K-maps with different size of input variables (1 to 4). b. To map SOP expressions on K-maps. c. To develop minimized expressions from K-maps.. d. To construct K-map from a non-structured SOP expression.						
		Active	**15. To evaluate the properties of Latches, Flip-Flops, and timers.** a. To contrast between Latches and Flip-Flops. b. To evaluate the properties of edge-triggered J-K Flip-Flop. c. To evaluate the properties of edge-triggered D Flip-Flop. d. To evaluate the properties of edge-triggered S-R Flip-Flop. e. To utilize the asynchronous Preset and Clear inputs of Flip-Flops. f. To examine the operating characteristics of Flip-flops, such as- propagation delay times, set-up time, hold time, Maximum clock frequency, Pulse width, and Power dissipation. g. To compare the properties of commercially						

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
			available Flip-Flop ICs.						
B. Apply current knowledge and adapt to emerging applications of math, science, engineering, and technology. **NIU Gen Ed Goals** - ***Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	**Active and Passive**	**3. To distinguish the conversion methods for various number systems.** a. To convert between binary and decimal b. To convert between binary and hexadecimal c. To convert between binary and octal						
		Active and passive	**6. To analyze the properties of fixed-function logic integrated circuits (IC): Complementary Metal Oxide Semiconductor (CMOS) and Transistor-Transistor Logic (TTL).** a. To identify various supply voltage and power requirements for CMOS and TTL ICs. b. To analyze the generic numbering convention for CMOS and TTL ICs. c. To classify common logic gate ICs according to their standard identifier digit. d. To examine the logic gate configuration within an IC. e. To compare alternative logic symbols for representing logic gates while drawing a circuit diagram. f. To examine the voltage values for input output logic levels for CMOS and TTL ICs.						
		Active and passive	**9. To analyze digital logic circuits using Boolean algebra.** a. To develop a Boolean expression for a given logic circuit. b. To evaluate a Boolean expression and prepare a truth-table for the logic circuit. c. To demonstrate the use of Boolean algebra while minimizing Boolean expressions.						
			12. To minimize logic expressions using						

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
		Active and passive **Active**	**Karnaugh map (K-map).** a. To develop K-maps with different size of input variables (1 to 4). b. To map SOP expressions on K-maps. c. To develop minimized expressions from K-maps. d. To construct K-map from a non-structured SOP expression. **16. To examine the use of Flip-Flops in practical applications.** a. To design parallel data storage using Flip-Flops. b. To implement frequency division using Flip-Flops. c. To design binary counter using Flip-Flops.						
C. Conduct, analyzes, and interprets experiments; apply experimental results to improve processes. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	**Active** **Active**	**13. To analyze digital systems using combinational logic.** a. To design a combinational logic system for a given problem. b. To design a logic circuit using standard logic gates from a given Boolean expression. c. To design a logic circuit from a truth table. d. To design logic circuit only with NAND or NOR gates. e. To analyze the operation of a combinational logic circuit with pulse inputs. f. To develop Boolean expression from a given logic circuit **14. To evaluate combinational logic circuits for commonly used digital functionalities: Half-adders and full-adders, parallel binary adders, comparators, BCD to decimal decodes, BCD to 7-segment decoders, encoders, multiplexers, and demultiplexers.** a. To examine their design principles		 	 	 		

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
			b. To develop combinational logic circuits using commercially available ICs to implement these common digital functionalities. c. To analyze the design of a magnitude comparator. d. To analyze the function of a decoder. e. To design and develop higher size decoder using smaller size decoder ICs. f. To explain the use of BCD-7-Segment decoder for a real-life application. g. To explain the design of encoders using commercial ICs. h. To analyze the function of an encoder. i. To evaluate the operation of multiplexers and their implementation using commercially available ICs. j. To evaluate the operation of demultiplexers and their implementation using commercially available ICs.						
		Passive	**17. To design applications using the 555 Timer** a. To use 555 timer for monostable operation. b. To use 555 timer for bistable operation. c. To use 555 timer for astable operation.						
		Active	**18. To design and study of counter applications using Flip-Flops.** a. To design and analyze asynchronous binary counters. b. To design and analyze asynchronous decade counter. c. To design and analyze synchronous binary counter. d. To design and analyze synchronous BCD decade counter e. To design and analyze up/down synchronous counter						

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
		Active	**19. To design and study of various shift register applications.** a. To demonstrate the use of D Flip-Flop as a shift register. b. To design and develop serial In/ serial Out shift register. c. To design and develop serial In/ parallel Out shift register. d. To design and develop parallel In/ serial Out shift register. e. To design and develop parallel In/ parallel Out shift register. f. To design and develop bi-directional shift register.						
D. Ability to apply creativity in the design of systems, components, or processes appropriate to program objectives. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	**Active**	**14. To evaluate combinational logic circuits for commonly used digital functionalities: Half-adders and full-adders, parallel binary adders, comparators, BCD to decimal decodes, BCD to 7-segment decoders, encoders, multiplexers, and demultiplexers.** a. To examine their design principles b. To develop combinational logic circuits using commercially available ICs to implement these common digital functionalities. c. To analyze the design of a magnitude comparator. d. To analyze the function of a decoder. e. To design and develop higher size decoder using smaller size decoder ICs. f. To explain the use of BCD-7-Segment decoder for a real-life application. g. To explain the design of encoders using commercial ICs. h. To analyze the function of an encoder. i. To evaluate the operation of multiplexers and						

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone Passive Participating Active	Student Learning Objectives	Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
			their implementation using commercially available ICs. j. To evaluate the operation of demultiplexers and their implementation using commercially available ICs.						
		Active	**18. To design and study counter applications using Flip-Flops.** a. To design and analyze asynchronous binary counters. b. To design and analyze asynchronous decade counter. c. To design and analyze synchronous binary counter. d. To design and analyze synchronous BCD decade counter e. To design and analyze up/down synchronous counter						
		Active	**19. To design and study various shift register applications.** a. To demonstrate the use of D Flip-Flop as a shift register. b. To design and develop serial In/ serial Out shift register. c. To design and develop serial In/ parallel Out shift register. d. To design and develop parallel In/ serial Out shift register. e. To design and develop parallel In/ parallel Out shift register. f. To design and develop bi-directional shift register.						

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone** **Passive Participating Active**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
E. Function effectively on teams. **NIU Gen Ed Goals-Students:** ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
F. Identify, analyze, and solve technical problems. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	**Passive and active**	**7. To analyze the performance characteristics and parameters for logic gates and evaluate their significance in digital design.** a. To estimate the propagation delay for a given logic gate and realize its significance in digital design. b. To estimate the speed-power product as a measure of the performance of a logic circuit. c. To estimate fan-out and loading conditions while designing a logic circuit. d. To interpret data sheets for different logic gate ICs. e. To evaluate data sheet information while making design decisions.						
		Active and passive	**9. To analyze digital logic circuits using Boolean algebra.** a. To develop a Boolean expression for a given						

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone** **Passive Participating Active**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension** **Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
			logic circuit. b. To evaluate a Boolean expression and prepare a truth-table for the logic circuit. c. To demonstrate the use of Boolean algebra while minimizing Boolean expressions.						
		Active	**13. To analyze digital systems using combinational logic.** a. To design a combinational logic system for a given problem. b. To design a logic circuit using standard logic gates from a given Boolean expression. c. To design a logic circuit from a truth table. d. To design logic circuit only with NAND or NOR gates. e. To analyze the operation of a combinational logic circuit with pulse inputs. f. To develop Boolean expression from a given logic circuit						
		Active	**14. To evaluate combinational logic circuits for commonly used digital functionalities: Half-adders and full-adders, parallel binary adders, comparators, BCD to decimal decodes, BCD to 7-segment decoders, encoders, multiplexers, and demultiplexers.** a. To examine their design principles b. To develop combinational logic circuits using commercially available ICs to implement these common digital functionalities. c. To analyze the design of a magnitude comparator. d. To analyze the function of a decoder. e. To design and develop higher size decoder using smaller size decoder ICs. f. To explain the use of BCD-7-Segment decoder for a real-life application.						

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
			g. To explain the design of encoders using commercial ICs. h. To analyze the function of an encoder. i. To evaluate the operation of multiplexers and their implementation using commercially available ICs. j. To evaluate the operation of demultiplexers and their implementation using commercially available ICs.						
		Active	**18. To design and study counter applications using Flip-Flops.** a. To design and analyze asynchronous binary counters. b. To design and analyze asynchronous decade counter. c. To design and analyze synchronous binary counter. d. To design and analyze synchronous BCD decade counter e. To design and analyze up/down synchronous counter						
		Active	**19. To design and study various shift register applications.** a. To demonstrate the use of D Flip-Flop as a shift register. b. To design and develop serial In/ serial Out shift register. c. To design and develop serial In/ parallel Out shift register. d. To design and develop parallel In/ serial Out shift register. e. To design and develop parallel In/ parallel Out shift register. f. To design and develop bi-directional shift register.						

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
G. Communicate effectively in writing. **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
H. Communicate effectively orally. **NIU Gen Ed Goals - Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.*** a***ii. communicate in a manner that unites theory, criticism, and practice in speaking & writing.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
I. Recognize the need for, and an ability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv.** ***are able to access and use various information sources. Internet, text, and field case.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	**Active** **Active**	**13. To analyze digital systems using combinational logic.** a. To design a combinational logic system for a given problem. b. To design a logic circuit using standard logic gates from a given Boolean expression. c. To design a logic circuit from a truth table. d. To design logic circuit only with NAND or NOR gates. e. To analyze the operation of a combinational logic circuit with pulse inputs. f. To develop Boolean expression from a given logic circuit **14. To evaluate combinational logic circuits for commonly used digital functionalities: Half-adders and full-adders, parallel binary adders, comparators, BCD to decimal decodes, BCD to 7-segment decoders, encoders, multiplexers, and demultiplexers.** a. To examine their design principles b. To develop combinational logic circuits using commercially available ICs to implement these common digital functionalities. c. To analyze the design of a magnitude comparator. d. To analyze the function of a decoder. e. To design and develop higher size decoder using smaller size decoder ICs. f. To explain the use of BCD-7-Segment decoder for a real-life application. g. To explain the design of encoders using commercial ICs. h. To analyze the function of an encoder. i. To evaluate the operation of multiplexers and their implementation using commercially available ICs.		  	  	  		

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone Passive Participating Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
		Active **Active**	j. To evaluate the operation of demultiplexers and their implementation using commercially available ICs **18. To design and study counter applications using Flip-Flops.** a. To design and analyze asynchronous binary counters. b. To design and analyze asynchronous decade counter. c. To design and analyze synchronous binary counter. d. To design and analyze synchronous BCD decade counter e. To design and analyze up/down synchronous counter **19. To design and study various shift register applications.** a. To demonstrate the use of D Flip-Flop as a shift register. b. To design and develop serial In/ serial Out shift register. c. To design and develop serial In/ parallel Out shift register. d. To design and develop parallel In/ serial Out shift register. e. To design and develop parallel In/ parallel Out shift register. f. To design and develop bi-directional shift register.						

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
J. Understand professional, ethical, and social responsibilities. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
K. Respect for diversity and a knowledge of contemporary professional, societal, and global issues. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
L. Commitment to quality, timeliness, and continuous	Factual Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
		Passive Participating Active		Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
improvement.	Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
M. Ability to program computers and/or utilize computer applications effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
N. Ability to use modern laboratory techniques, skills, and/or equipment effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	**Bloom's Knowledge Dimension**	**Dale's Cone**	**Student Learning Objectives**	**Bloom's Cognitive Process Dimension**					
		Passive Participating Active		**Knowledge Remember**	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
O. Ability to manage projects effectively. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
P. Ability to design, manipulate, and manage industrial systems. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

Q. Ability to manage or lead personnel effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

Note: Additional educational outcomes -NIU General Education Goals - articulated by the overall program

ABET Engineering Outcomes Abhijit Gupta MEE 321	Bloom's Knowledge Dimension	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
A. Apply knowledge of math, science, engineering **NIU Gen Ed Goals - *Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	√ Factual Knowledge √Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	Active	1 B. a Define degrees of Freedom		*	*	*		
			1 B b Solve Particle Kinematics problems for i) Velocity analysis, and ii) Acceleration analysis	*	*	*	*		
			1 B c Solve Rigid Body Kinematics problems for i) Relative Velocity analysis ii) Relative Acceleration analysis	*	*	*	*		
			1 B d Decide how to choose Particle and/or Rigid Body formulation	*	*	*	*		
			1 B e Solve the kinetics problem i) Identify method of solution by identifying list of variables ii) Draw FBD and MAD to solve for instantaneous forces/accelerations			* *	* *		
			5 a i) Identify the appropriate 2DOF ii) Construct FBD and MAD in terms of the chosen 2DOF			*	*		
			5 b Use the FBD and MAD to derive equations of motion			*	*		
			7 a Derive equations for MDOF systems & solve for natural frequencies and mode shapes in closed form.			*	*		
			7 b i) Check orthogonalilty of mode shapes with respect to mass and stiffness matrices ii) Use the orthogonality to decouple equations of motion. iii) Compute mass normalized mode shapes.	*	*	* *			

ABET Engineering Outcomes Abhijit Gupta MEE 321	Bloom's Knowledge Dimension	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
			7 e i) Decouple equations of motion using separation of variables					*	
			9 c Solve for eigenvalues (square of natural frequencies) and eigenvectors (mode shapes) of undamped 2DOF and MDOF systems using eig command				*		
			9 d Solve equation of motion for a 2DOF system such as automobile using state space method.					*	
			8 a Use function generator to generate a periodic wave and use the analyzer to measure the Fourier components		*	*	*		
			8 b i) Measure natural frequency of a SDOF system using impact hammer, accelerometer, and FFT analyzer ii) Measure damping ratio using half power points iii) Understand various sources of error including digital signal processing issues and effect of sensors		*	*	*	*	

ABET Engineering Outcomes Abhijit Gupta MEE 321	Bloom's Knowledge Dimension	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
B. Design and conduct experiments; analyze and interpret data **NIU Gen Ed Goals -** ***Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	Active	8 c i) Measure natural frequencies and mode shapes of a 2DOF system using impact hammer, accelerometer, and FFT analyzer. ii) Use imaginary part of transfer functions to obtain modal parameters. iii) Obtain damping ratios		*	*	*		

C. Design a system, component, process to meet desired needs within realistic constraints, e.g. economic, environmental, social, political, ethical, health, safety, manufacturability, & sustainability. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	Active	4 f Design systems for desired vibration isolation 10 a i) Formulate equation of motion of SDOF system and suggest appropriate stiffness/damping for desired vibration isolation ii) Formulate equation of motion of 2DOF systems and suggest appropriate stiffness/damping for desired vibration isolation 10 b Design a tuned absorber system for vibration prevention at a resonant forcing frequency while satisfying design constraints such as maximum displacement				* * * *	* * * *	* * * *

D. Function on multi-disciplinary teams. **NIU Gen Ed Goals- Students:** ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	Active	8 b i) Measure natural frequency of a SDOF system using impact hammer, accelerometer, and FFT analyzer ii) Measure damping ratio using half power points iii) Understand various sources of error including digital signal processing issues and effect of sensors 8 c i) Measure natural frequencies and mode shapes of a 2DOF system using impact hammer, accelerometer, and FFT analyzer. ii) Use imaginary part of transfer functions to obtain modal parameters. iii) Obtain damping ratios			* * * *	* * *		

E. Identify, formulate, and solve engineering. problems **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	Active	1A. a Discuss common vibration phenomenon		*	*	*		
			i) Identify if vibration is Deterministic and classify as a)Sinusoidal, b) Periodic, and c) Transient		*	*	*		
			ii) Identify if vibration is Random and classify as a) Stationary and b) Non Stationary		*	*	*		
			1 A b Identify the source of excitation as i) Free or ii)Forced Vibration		*	*	*		
			1 A c Identify possible source of energy loss and classify as i) Undamped or ii) Damped		*	*	*		
			1 A d Classify the system as i) linear or ii) nonlinear		*	*	*		
			1 B a Define degrees of Freedom		*	*	*		
			1 C i) Convert a complex system to simple sub-systems				*	*	
			ii) Draw the Schematic of the sub-systems					*	
			1 D a Compute equivalent stiffness for i) springs in series ii) springs in parallel, or iii) combined effect in a SDOF system			*	*		
			1 D b Compute equivalent mass			*			
			1 E a Define basic vibration terminology for sinusoidal motion	*	*				
			i) Obtain Fourier series expansion for periodic motion ii) Reconstruct a periodic wave from first few harmonics						

			2 A a Identify the degree of freedom		*	*			
			2 A b i) Derive equation of motion for undamped translation system				*		
			ii) Solve the differential equation of motion and compute natural frequency				*		
			2 A c i) Derive equation of motion for undamped rotational system				*		
			ii) Solve the differential equation of motion and compute natural frequency				*		
			2 B a i) Use compound pendulum for solving moment of inertia					*	
			ii) Compute center of percussion and use it for sports applications					*	
			2 C a Compute equivalent mass and system and check if system is stable				*		
			3. A a Derive equation of motion of a viscously damped SDOF system			*	*		
			3. A. b Compute Critical Damping Constant and Damping ratio			*	*		
			3. A. c Solve for the response of i) underdamped, ii)critically damped and iii) overdamped system due to given initial conditions			*	*		

			3 A. d Compare the undamped and damped natural frequencies and understand its relevance in terms of comparison of theory and experiment				*	*	
			3 A. e Use log decrement to measure damping.			*	*		
			3 B. a Identify other types of damping.			*	*		
			3 B. b Derive the equation for columb damping			*	*		
			3 B c Compute energy loss for hysteretic damping			*	*		
			4 a Derive the equation of motion from FBD & MAD			*	*		
			4 b i)Use the FBD and MAD to solve for the steady state solution due to harmonic excitation			*	*		
			ii) Compute the total response			*	*		
			iii) Estimate damping ratio from half power bandwidth		*	*	*		
			4 c Define transmissibility and observe the effect of damping and frequency ratios on transmissibility		*	*	*	*	
			4 d Solve for the response of a system due to motion of base			*	*	*	
			4 e Solve for the response of a system subjected to rotating unbalance			*	*	*	
			5 b Use the FBD and MAD to derive equations of motion			*	*		
			5 c Identify mass, stiffness, and damping matrices from the equations of motion			*	*		
			5 d Solve for undamped natural frequencies and mode shapes.			*	*		

			5 e Solve for modal properties of a semidefinite systems			*	*		
			6 a Use the equation of motion to solve for steady state response due to harmonic excitation directly by impedance method			*	*		
			7 a Derive equations for MDOF systems & solve for natural frequencies and mode shapes in closed form.			*	*		
			7 b i) Check orthogonalilty of mode shapes with respect to mass and stiffness matrices			*	*		
			ii) Use the orthogonality to decouple equations of motion.			*	*		
			iii) Compute mass normalized mode shapes						
			7 d i) Define Proportional and non proportional damping		*	*	*		
			ii)Solve for damping ratios for the case of proportional damping						
			7 e ii) Solve for the response using mode shapes and generalized coordinates			*	*		
			7 e iii) Solve response of a large DOF systems in terms of first few modes and generalized coordinates			*	*	*	
			9 d Solve equation of motion for a 2DOF system such as automobile using state space method.			*	*		
			11 a Identify various sources of periodic forces and use Fourier analysis to solve for response of SDOF system subjected to periodic force		*	*	*	*	
			11 b Identify various sources of transient forces and solve for response of SDOF system subjected to the transient forces			*	*	*	

F. Understand professional and ethical responsibility **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***									
G. Communicate effectively **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	√Factual Knowledge √Conceptual Knowledge √Procedural Knowledge √Meta-Cognitive Knowledge	Active	8 a Use function generator to generate a periodic wave and use the analyzer to measure the Fourier components 8 b i) Measure natural frequency of a SDOF system using impact hammer, accelerometer, and FFT analyzer ii) Measure damping ratio using half power points iii) Understand various sources of error including digital signal processing issues and effect of sensors 8 c i) Measure natural frequencies and mode shapes of a 2DOF system using impact hammer, accelerometer, and FFT analyzer. ii) Use imaginary part of transfer functions to obtain modal parameters. iii) Obtain damping ratio		* * * * *	* * * * *	* * * * *	*	

H. understand impact of engineering solutions in a global economic, environmental, societal context **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	√Factual Knowledge √Conceptual Knowledge √Procedural Knowledge √Meta-Cognitive Knowledge	Active	10. A. i) Formulate equation of motion of SDOF system and suggest appropriate stiffness/damping for desired vibration isolation ii) Formulate equation of motion of 2DOF systems and suggest appropriate stiffness/damping for desired vibration isolation B. Design a tuned absorber system for vibration prevention at a resonant forcing frequency while satisfying design constraints such as maximum displacement		*	*	*	*	*
I. Recognize the need for, and have capability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv.** ***are able to access and use various information sources. Internet, text, and field case.***	√Factual Knowledge √Conceptual Knowledge √Procedural Knowledge √Meta-Cognitive Knowledge	Active	9 A. a) Reconstruct a periodic wave from first few harmonics and plot using Matlab b) To solve for complete solution for response of a SDOF using Matlab c)Solve for eigenvalues (square of natural frequencies) and eigenvectors (mode shapes) of undamped 2DOF and MDOF systems d) Solve equation of motion for a 2DOF system such as automobile using state space method	*	*	*	*		

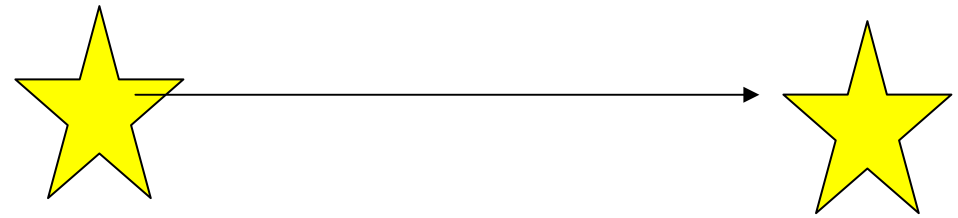
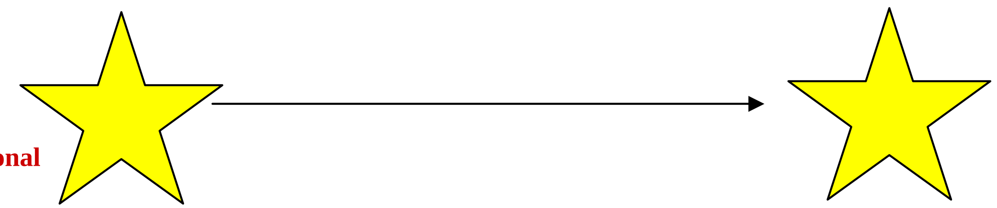
J. knowledge of contemporary issues **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for***	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	Active	10 a i) Formulate equation of motion of SDOF system and suggest appropriate stiffness/damping for desired vibration isolation ii) Formulate equation of motion of 2DOF systems and suggest appropriate stiffness/damping for desired vibration isolation 10 b Design a tuned absorber system for vibration prevention at a resonant forcing frequency while satisfying design constraints such as maximum displacement 11 c Define response spectrums and discuss their use in structural design			* * * *	* * * *	* * * *	* * * *
K. use techniques, skills, and modern engineering tools necessary for engineering practice	√ Factual Knowledge √ Conceptual Knowledge √ Procedural Knowledge √ Meta-Cognitive Knowledge	Active	6 b Use Matlab to solve the equations of motion directly and by state space method 7 c Solve for natural frequencies and mode shapes by Matlab 9 a Reconstruct a periodic wave from first few harmonics and plot using Matlab 9 b To solve for complete solution for response of a SDOF using Matlab 9 c Solve for eigenvalues (square of natural frequencies) and eigenvectors (mode shapes) of undamped 2DOF and MDOF systems using eig command			* * * * *	* * * * *	* * * * *	

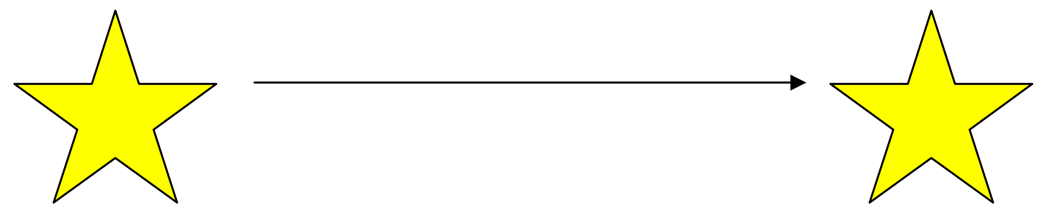
Addition: Additional educational outcomes -NIU General Education Goals - articulated by the overall program

Table B.7.b.3: Technology 496 Industrial Project Management – Senior Design Capstone (Scarborough, 2005)

★ = range of cognitive processing
√ = yes on if Bloom's knowledge category is met

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension: Knowledge / Remember — Comprehension / Understand — Application / Apply — Analysis / Analyze — Synthesis / Evaluate — Evaluate / Create
A. Mastery of knowledge, techniques, skills, modern tools of disciplines.	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**6. To demonstrate effective project:** **a. planning** **b. initiation** **c. execution** **d. termination**	
B. Apply current knowledge and adapt to emerging applications of math, science, engineering, and technology. **NIU Gen Ed Goals -** ***Students:*** ***a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**8. To integrate mathematics, the sciences, communication, management, technical, and technological knowledge and skills to accomplish team and project objectives.**	
C. Conduct, analyze, and interpret experiments; apply experimental results to improve processes. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:		**NA**	

Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension Knowledge Remember / Comprehension Understand / Application Apply / Analysis Analyze / Synthesis Evaluate / Evaluate Create
D. ability to apply creativity in the design of systems, components, or processes appropriate to program objectives. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**8. To integrate mathematics, the sciences, communication, management, technical, technological knowledge and skills to accomplish team and project objectives.** **a. design a vehicle to technical specifications** **b. build the vehicle to technical specifications** **c. solve technical problems associated with design, construction, and evaluation** **d. test and evaluate vehicle against technical specifications**	
E. Function effectively on teams. **NIU Gen Ed Goals-Students:** ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge √ Meta-cognitive Knowledge:	Active	**1. To identify and describe major problems, issues, concerns, and solutions that relate to projects, PM, Pteams, and P leaders, international projects, and multi-cultural teams.** **2. To identify and describe best practices for managing projects and leading teams, including international projects and multi-cultural teams.** **3. To perform effectively on a project team (multi-cultural when possible)** **a. To engage in conflict resolution to resolve team issues.**	

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension
				Knowledge Remember / **Comprehension Understand** / **Application Apply** / **Analysis Analyze** / **Synthesis Evaluate** / **Evaluate Create**
F. Identify, analyze, and solve technical problems. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**8. To integrate mathematics, the sciences, communication, management, technical, technological knowledge and skills to accomplish team and project objectives.** **a. design a vehicle to technical specifications** **b. build the vehicle to technical specifications** **c. solve technical problems associated with design, construction, and evaluation** **d. test, evaluate vehicle against technical specifications.**	
G. Communicate effectively in writing. **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**9. To design, develop, prepare, and deliver** **a. executive team presentation** **b. team portfolio** **c. team website**	

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension
				Knowledge Remember / Comprehension Understand / Application Apply / Analysis Analyze / Synthesis Evaluate / Evaluate Create

H. Communicate effectively orally.

> **NIU Gen Ed Goals - Students:**
> ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.***
> ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***
> a***ii. communicate in a manner that unites theory, criticism, and practice in speaking & writing.***

√ Factual Knowledge: — Active

√ Conceptual Knowledge:

√ Procedural Knowledge:

√ Meta-cognitive Knowledge:

7. To demonstrate effective project
a. planning
b. initiation
c. execution
d. termination

9. To design, develop, prepare, and deliver
a. team presentation
b. team portfolio
c. team website

I. Recognize the need for, and an ability to engage in life long learning.

> **NIU Gen Ed Goals - Students:**
> **a.iv.** ***are able to access and use various information sources. Internet, text, and field case.***

√ Factual Knowledge: — Intermediate **Active**

√ Conceptual Knowledge:

Procedural Knowledge:

Meta-cognitive Knowledge:

1. To identify and describe major problems, issues, concerns, and solutions that relate to projects, project management, project teams, and project leaders, including international projects and multi-cultural teams.

2. To identify and describe best practices for managing projects and leading teams, including international projects and multi-cultural teams.

J. Understand professional, ethical, and social responsibilities.

> **NIU Gen Ed Goals - Students:**
> ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***

√ Factual Knowledge: — Active

√ Conceptual Knowledge:

√ Procedural Knowledge:

√ Meta-cognitive Knowledge:

5. To exhibit leadership by engaging in a team community service project.

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension Knowledge Remember	 Comprehension Understand	 Application Apply	 Analysis Analyze	 Synthesis Evaluate	 Evaluate Create
K. Respect for diversity and a knowledge of contemporary professional, societal, and global issues. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-cognitive Knowledge:	Active	**3. To perform effectively on a project team (multicultural when possible).** **a. To engage in conflict resolution to resolve team issues.**			★			
L. Commitment to quality, timeliness, and continuous improvement.	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-cognitive Knowledge:	Active	**6. To demonstrate effective project** **a. planning** **b. initiation** **c. execution** **d. termination** **3. To perform effectively on a project team (multicultural when possible)** **a. To engage in conflict resolution to resolve team issues.**	★					★
			8. To integrate mathematics, the sciences communication, management, technical and team and project objectives. **a. design a vehicle to technical specifications** **b. build the vehicle to technical specifications** **c. solve technical problems associated with project design, construction, and evaluation** **d. test and evaluate vehicle against technical specifications**	★					★
M. Ability to program computers and/or utilize computer applications effectively.	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-Cognitive Knowledge:	Active	**6. To demonstrate effective project** **a. planning** **b. initiation** **c. execution** **d. termination**			★	★		

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
N. Ability to use modern laboratory techniques, skills, and/or equipment effectively.	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-Cognitive Knowledge:	Active	**8. To integrate mathematics, the sciences communication, management, technical and technological knowledge and skills to accomplish team and project objectives.** **a. design a vehicle to technical specifications** **b. build the vehicle to technical specifications** **c. solve technical problems associated with project design, construction, and evaluation** **d. test and evaluate vehicle against technical specifications**						

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension

Bloom's Cognitive Process Dimension: Knowledge Remember | Comprehension Understand | Application Apply | Analysis Analyze | Synthesis Evaluate | Evaluate Create

O. Ability to manage projects effectively.

NIU Gen Ed Goals - Students:
c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.

√Factual Knowledge:

√Conceptual Knowledge:

√Procedural Knowledge:

√Meta-cognitive Knowledge:

Active

1. To identify an describe major problems, issues, concerns, and solutions that relate to projects, Pmanagement, P teams and P leaders, including international projects and leading multicultural teams.

2. To identify and describe best practices for managing projects and leading teams, including international projects and multi cultural teams.

3. To perform effectively on a project team (multicultural team when possible).

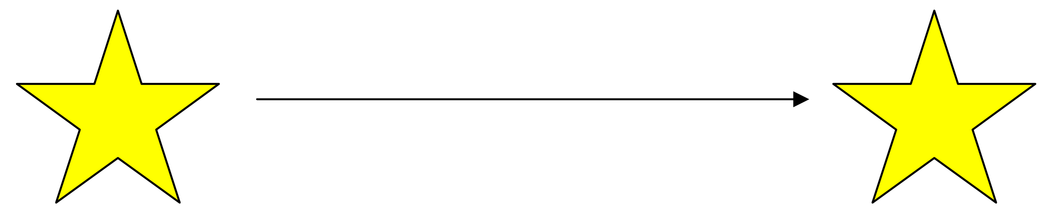
Active

4. To prepare the team for project work by
a. developing a team operations manual
b. developing a peer and team assessment system
c. creating the team organization and process
d. developing a team project plan

6. To demonstrate project
a. planning
b. initiation
c. execution
d. termination
e. problem solving

7. To demonstrate effective use of project management techniques and tools in the management of a technical project.
a. the development of a project plan
b. use of MS Project
c. use of appropriate financial planning and operations procedures
d. use of appropriate procurement procedures
e. scheduling techniques
f. use of the MACE process

9. To design, develop, prepare, and deliver
a. executive team presentation
b. team portfolio
c. team website

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension Knowledge Remember / Comprehension Understand / Application Apply / Analysis Analyze / Synthesis Evaluate / Evaluate Create
P. Ability to design, manipulate, and manage industrial systems. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:		**NA**	
Q. Ability to manage or lead personnel effectively.	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-cognitive Knowledge:	Active	**3. To perform effectively on a project team (multicultural when possible).** **a. To engage in conflict resolution to resolve team issues.** **b. To engage in the leadership of the team, team members, or work package sub-team members.**	
			4. The team will prepare project work by **a. developing a team operations manual** **b. developing a peer and team assessment system** **c. creating the team organization and process** **d. developing a team project plan**	
			5. To exhibit leadership while engaged in a team community service project **a. plan** **b. initiate** **c. execute** **d. terminate** **e. report**	

Note: additional educational outcomes articulated by the overall program ** See in text boxes above - NIU General Education Goals

COURSE CONTENT SCHEDULE TEACHING AND LEARNING ANALYSIS
JULE DEE SCARBOROUGH, PH.D.
(See Program in A.5 and Worksheets in C.1)

Once the professors had analyzed their 2005 courses and tests and redeveloped the student learning outcomes for the 2006 courses, they created a course content calendar for the 2006 courses. These professors had never included a course calendar, noting due dates, the topics and activities for each course day, and more, in their syllabus. That was a syllabus requirement, so we created the new 2006 course calendar. However, we also used the course calendar as a quality check tool. In addition to its intended purpose, to communicate what was going on or expected in the course from the students, each professor used it as an analysis tool and graphic organizer to determine if the newly developed student learning outcomes for the 2006 courses, designed to more actively engage students in learning and to present the opportunity to use a variety of teaching models and styles, did so. Each professor took the legend below and identified by course day which teaching models and styles could be used. They also considered and noted what student learning styles were possible for each day and, finally, if they could expect to achieve the upper levels of Bloom's Cognitive Dimension and if the learning was active according to Dale's Cone of Learning. This gave the professors a visual or graphic organizer of the teaching and learning context for the course, using the actual course calendar to be included on the syllabus later when developing the whole syllabus during that program component. The calendar approach clearly revealed any gaps in the desired quality criteria of diversity in teaching models and styles; diversity in learning styles, achieving the upper levels of Bloom's Taxonomy, and if learning was active, rather than passive, according to Dale's Cone of Learning.

Course Schedule Reflecting Teaching Models and Styles; Student Learning Styles; Bloom's Cognitive Dimension; and, Dale's Active Learning

3 Faculty Samples follow the Legend (Tables B.8.1-3)

Teaching Learning Calendar/Content Analysis Legend

<u>Teaching Models</u>
(Joyce, Weil, Calhoun, 2004)

IT – inductive thinking
CA - concept attainment
PWIM – picture word induction model
ScI – scientific inquiry
M – mneumonics
S – synectics
AO – advance organizers
Partners
CL-I – cooperative learning-informal
CL-F – cooperative learning-formal
SI – structured inquiry
GI – group investigation
RP – role playing
JI – jurisprudential inquiry
NT – nondirective teaching
ES – enhancing self-esteem
ML – mastery learning
PS – programmed schedule
DI – direct instruction
S - simulation

<u>Teaching Styles</u>
(Mosston & Ashworth, 1990)

C – command (A)
P – practice (B)
R – reciprocal (C)
SC – self check (D)
I – inclusion (E)
GD – guided discovery (F)
CD – convergent discovery (G)
DP – divergent production (H)
LD – learner designed (I)
LI – learner initiated)J)
ST – self teach (K)

<u>Teaching Styles</u>
(Grasha, 1996)
E – expert
FA – formal authority
PM – personal model
F - facilitator
D – delegator

<u>Kolb's Learning Styles</u>
(Kolb, 1984)

CE – concrete expeience
RO – reflective observation
AC – abstract conceptualization
AE – active experimentation

<u>Bloom (1956)</u>
K-R – knowledge or remember
C-U – comprehension or understanding
Ap - application or apply
An - analyze
S-E - synthesize or evaluate
E-C - evaluate or create

<u>Dale's Cone of Learning</u>
(Dale, 1969)
P – passive (listening only)
I – intermediate
(participating in discussion)
A – active (doing)

Table B.8.1: Faculty Sample 1. **IENG370 – Moraga VI.Course Topics, Class Schedule & Due Dates**

Week & Objectives	**TM** **TS**	**LS**	**Day 1 Topics/Learning Activities Due Dates**	**TM** **TS**	**LS**	**Day 2 Topics/Learning Activities Due Dates**
Week 8/28 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems, (2.1) choose real-world problem	**DI** **CS**	**AC/ RO**	Introduction **Individual work: formulation case study 1 handed out**	**IT** **DI** **GDS**	**AC/ RO**	Linear Programming - assumptions - graphical method **Group work: formulation case study 1 analyzed**
Week 9/4 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems, (2.1) choose real-world problem, (2.2) define the problem & (2.3) define the problem	**DI** **CS**	**CE/ RO**	Linear Programming - classical examples - LP formulation	**IT** **GDS**	**AC/ RO**	Linear Programming - LP formulation **Group work: formulation case study 2**
Week 9/11 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems, (2.4) solve the problem using SA	**DI** **CS**	**CE/ RO**	Linear Programming - standard LP form - reduction techniques **Individual work: rubric on simplex method handed out**	**IT** **GDS**	**AC/ RO**	Linear Programming - LP tabular form - Simplex Algorithm fundamentals **Group work: rubric on simplex method analyzed**
Week 9/18 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems, (2.4) solve the problem using SA			Linear Programming - SA mechanic			Linear Programming - big M - two phase method
Week 9/25 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems, (2.5) solve the problem using SA			Duality Theory and Sensitivity Analysis - economic interpretation - primal-dual relationship			Duality Theory and Sensitivity Analysis - dual-simplex method - sensitivity analysis
Week 10/2 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems, (2.5) solve the problem using SA			Duality Theory and Sensitivity Analysis - sensitivity analysis			Duality Theory and Sensitivity Analysis - sensitivity analysis - use of LINDO
Week 10/9 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems			Transportation Problem - formulation and mathematical structure - applications			Transportation Problem - tabular form - algorithm
Week 10/16 - MIDTERM 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems			Transportation Problem - algorithm, example			
Week 10/23 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems			Assignment Problem - formulation, math structure, algorithm and example			Network Flow Models - terminology - shortest path problem

Week 10/30 1. Apply OR methods to industrial problems, (1.1) apply LP models 2. Apply LP model to real-world problems			Network Flow Models - maximum spanning tree - maximum flow problem			Network Flow Models - maximum flow problem - minimum cost flow problem
Week 11/6 1. Apply OR methods to industrial problems, (1.1) apply LP models & (1.2) apply IP models			Network Flow Models - minimum cost flow problem			Integer Programming - assumptions and formulation - applications
Week 11/13 1. Apply OR methods to industrial problems, (1.2) apply IP models			Integer Programming - applications - Branch and Bound algorithm			Integer Programming - Branch and Bound algorithm - examples
Week 11/20 1. Apply OR methods to industrial problems, (1.3) understand basic knowledge of DP			Dynamic Programming - characteristics of DP			**11/23 THANKSGIVING**
Week 11/27 1. Apply OR methods to industrial problems, (1.3) acquire basic knowledge of DP			Dynamic Programming - steps in DP			Dynamic Programming -example
Week 12/4 2. Apply LP model to real-world problems, (2.6) communicate results			Project presentations			Project presentations
Week 12/11 FINAL EXAM						

Table B.8.2: **Faculty Sample 2.** **VI. Course Topics, Class Schedule & Due Dates** **Abul Azad-Technology 277**

Week Obj	**TM TS**	**LS**	**B**	**D**	**Topics/Lab Activities & Due Dates**	**TM TS**	**LS**	**B**	**D**	**Topics/Lab Activities & Due Dates**
1 8/28	**Inductive thinking / F**	**Assimilating**	Comprehension		Digital Concepts	**Direct instruction and inductive thinking/F**	Assimilating	Application	Receiving /participating	Number Systems
2 9/4	**Concept attainment , and Direct instruction / B, F**	Assimilating	Comprehension	Receiving / participating	Number Systems	**Concept attainment and direct instruction / B, F**	Assimilating	Comprehension	Receiving / participating	Logic Gates
3 9/11	**Concept attainment, and Direct instruction / A**	Assimilating	Application	Receiving / Participating	Logic Gates	**Concept attainment and direct instruction / B**	Assimilating	Comprehension / application	Receiving / Participating	Logic Gates
4 9/18	**Inductive thinking / B, D**	Assimilating	Application	Receiving / Participating	Logic Gates	**Direct instruction, Content attainment, and Partners in learning / A, B, H**	Assimilating / Diverging	Comprehension	Receiving / Participating	Boolean Algebra and Logic Simplification **Performance Test-1**
5 9/25	**Content attainment, and Inductive thinking / B, D**	Assimilation	Application	Receiving / Participating	Boolean Algebra and Logic Simplification	**Direct instruction, and Content attainment / A, B**	Assimilating	Comprehension	Receiving / Participating	Combinational Logic Analysis
6 10/2	**Inductive thinking, and Content attainment / B, D**	Assimilation	Application	Receiving / Participating	Combinational Logic Analysis	**Inductive thinking, and Content attainment / B, D**	Assimilation	Application	Doing	Combinational Logic Analysis
7 10/9	**Direct instruction, and Inductive thinking / A, B**	Assimilating	Comprehension	Visual receiving	Functions of Combinational Logic	**Inductive thinking, and Content attainment / B, D**	Assimilation	Application	Receiving / Participating	Functions of Combinational Logic
8-10/16 MT	**Mnemonics, Inductive thinking, and Content attainment / B, D**	Assimilation	Application	Receiving / Participating	Functions of Combinational Logic					**MIDTERM**
9 10/23	**Inductive thinking / B, D**	Assimilation	Application	Doing	Functions of Combinational Logic	**Inductive thinking, Partners in learning, Group investigation / B, D, H**	Assimilation / Diverging	Application	Doing	Functions of Combinational Logic **Performance Test-2**
10 10/30	**Direct instruction, and Inductive thinking / A, B**	Assimilating	Comprehension	Visual receiving	Latches, Flip-Flops, and Timers	**Content attainment and Inductive thinking / B, D**	Assimilation	Application	Receiving and participating	Latches, Flip-Flops, and Timers

11 11/6	**Content attainment and Inductive thinking / B, D**	Assimilation	Application	Receiving and participating	Latches, Flip-Flops, and Timers	**Direct instruction and Content attainment / A, B**	Assimilation	Comprehension	Visual Receiving and Participating	Counters
12 11/13	**Inductive thinking and Content attainment / B, D**	Assimilation	Comprehension	Receiving and Participating	Counters	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Visual Receiving and Participating	Counters
13 11/20	**Direct instruction and Content attainment / A, B**	Assimilation	Comprehension	Visual Receiving and Participating	Shift Registers					**11/23 THANKSGIVING**
14 11/27	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Receiving and Participating	Shift Registers	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Visual Receiving and Participating	Shift Registers
15 12/4	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Receiving and Participating	Shift Registers	**Inductive thinking, Partners in learning, Group investigation / B, D, H**	Assimilation / Diverging	Application	Doing	**Performance Test-3**
16-2/11 FE	**Inductive thinking and Content attainment / B, D**	Assimilation	Application	Receiving and Participating	Shift Registers					**Final Examination**

Table B.8.3: Faculty Sample 3. VI. Course Topics, Class Schedule & Due Dates

IENG 475- Decision Analysis – Regina Rahn

Week Obj	TS/TM	LS	Bloom/ Dale	Topics/Lab Activities & Due Dates	TS/TM	LS	Bloom/ Dale	Topics/Lab Activities & Due Dates
1 **8/28** Students will be able to construct/create a decision tree to aid in determining the best course of action for a given set of circumstances	C E / DI	AC	KR / P	**Introduction** Decision Analysis ***Decision Trees*** Structure and Outcomes	C E / DI	AC	KR, CU / P	**Decision Trees** Probability Overview **Decision Trees** Expected Value and EMV
2 **9/4** Students will be able to construct/create a decision tree to aid in determining the best course of action for a given set of circumstances Students will be able to perform sensitivity analysis on a decision tree scenario	C E / DI, AO	AC	KR, CU / P	**Decision Trees** EVPI and EVSI **Decision Trees** Probability Calculations – Baye's Theorem	C, P E, FA / DI, AO, IT, SI, DEDUCTIVE	AE, CE, AC, RO	KR, CU, AP / I	**Decision Trees** Sensitivity Analysis **Decision Trees** Case Study ***HW #1 Due*** (Students will be able to construct/create a decision tree to aid in determining the best course of action for a given set of circumstances)
3 **9/11** Students will be able to perform sensitivity analysis on a decision tree scenario	C, P E, FA / DI, AO, IT, SI, DEDUCTIVE	CE, AC, RO	KR, CU, A / I	**Decision Trees** Case Study Continued	R, SC, DP F / IT, SI, CL-I	CE, AE, AC, RO	AN, AP, SE / A	***Small Group Encounter*** (Students will be able to define a scenario to be analyzed with the decision analysis techniques Students will be able to formulate/design a possible solution approach to the given problem)

4 **9/18** Students will be able to construct the formulae for conditional likelihood ratios and to calculate the probabilities/ratios Students will be able to make inferences about a system based on the values of the conditional likelihood ratios	C, P E, FA / DI, SI	AE, AC	KR, CU, AP / P	**Decision Trees** Conditional Likelihood Ratios ***HW #2 Due*** (Students will be able to construct/create a decision tree to aid in determining the best course of action for a given set of circumstances Students will be able to perform sensitivity analysis on a decision tree scenario)	C, I, GD, CD, DP, E, FA, D / DI, SI, IT	AE, AC	KR, CU, AP, AN, SE, EC / P	**Utility Theory** Introduction Motivation and Axioms **Performance Task #1 – written report due** (To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario – a written report)
5 **9/25** Students will be able to construct a single-attribute utility function	C E / DI	AC	KR, CU / P	**Utility Theory** Degrees of Risk	R, I, CD, DP F, D / IT, SI	CE, AE, AC, RO / A		**Performance Task #1 – oral presentations** (To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario – a presentation)
6 **10/2** Students will be able to evaluate a given utility function To structure (and solve) complicated decision problems	C, P E, FA / DI, AO	CE, AC, RO	KR, CU, AP / I	**Utility Theory** Lotteries Lotteries – Calculations and Examples	R, I, CD, DP, LD F, D / DI, IT, SI, CL-F, STI, GI	AE, AC, RO	KR, CU, AP, AN, SE / P	**Utility Theory** Two Lotteries at a Time Single Attribute Utility Functions **Performance Task #2 – Phase 1: Project Selection Due** (Students will be able to define a scenario to be analyzed with the decision analysis techniques)

7 **10/9** To structure (and solve) complicated decision problems	P, R, CD FA, F / IT, SI, CL-I, STI, GI	CE, AE, AC, RO	AN, SE / A	**Class Discussion: Topic - Project Selection** ***HW #3 Due*** (Students will be able to construct a single-attribute utility function Students will be able to evaluate a given utility function)	P, R, CD FA, F / AO, IT, SI	CE, AE, AC, RO	AN, SE / A	**Interactive Review Session**
8-10/16 MT To learn to use a specific set of analytical tools for technical decision making under uncertainty. To apply analytic decision making techniques for technical decision making under uncertainty, and to analyze and evaluate the results. To structure and solve complicated decision problems To identify and define any limitations of the models and techniques for rational decision-making.	P FA / IT, SI, DEDUCTIVE	AE, AC	CU, AP, AN / A	***Midterm Exam***	C E / DI	AC, RO	KR / I	***Fault Trees*** ***(Discuss Midterm)***

9 **10/23** Students will be able to develop and analyze fault trees	C E / DI	AC, RO	KR / P	***Fault Trees*** Evaluation - Qualitative	C E / DI	AC	KR / P	***Fault Trees*** Evaluation - Quantitative
10 **10/30** Students will be able to evaluate the scenarios modeled by a fault tree	C, P E, FA / DI, AO, IT, SI	CE, AC, RO	KR, CU, AP / I	***Fault Trees*** Case Study Dual Fault Trees	R, I, CD, DP, LD F, D / IT, SI, CL-I, CL-F, STI, GI	CE, AE, AC, RO	AN, SE, EC / A	**Round Table Discussion** **Performance Task #2 – Phase 2: Formulate and Measure Due** (Students will be able to formulate/design a possible solution approach to the given problem Students will be able to implement the solution techniques to obtain a first round solution)
11 **11/6** Students will be able to construct a multi-attribute utility function Students will be able to implement the additive model for multi-attribute utility theory	C E / DI	AC	KR / P	**Multi-Attribute Utility Theory (MAU)** The General Case	C, P E, FA / DI	CE, AC, RO	KR, CU, AP / I	**Multi-Attribute Utility Theory (MAU)** Additive Functions Calculations and Examples
12 **11/13** Students will be able to develop and analyze fault trees Students will be able to evaluate the scenarios modeled by a fault tree Students will be able to evaluate a given utility function	P, R, CD FA, F / AO, IT, SI, CL-I	CE, AE, AC, RO	AP, AN / A	**Homework discussion** ***HW #4 Due*** Students will be able to develop and analyze fault trees Students will be able to evaluate the scenarios modeled by a fault tree) **Possible guest lecturer**	R, I, CD FA, F / AO, DEDUCTIVE, SI, CL-I	CE, AE, AC, RO	AP, AN / A	***Round Table Discussion of Handouts on MAU*** (Students will be able to evaluate a given utility function)

13 **11/20** Students will be able to construct a multi-attribute utility function Students will be able to implement the additive model for multi-attribute utility theory	C, R, I, CD, DP, LD E, F, D / DI, IT, SI, CL-F, STI, GI,	AE, AC, RO	KR, SE, EC / P	**Multi-Attribute Utility Theory (MAU)** More Calculations and Examples **Performance Task #3 – Phase 3: Analyze Summary Due** (Students will be able to analyze the solution found in order to assess the current state)				**11/23 Thanksgiving**
14 **11/27** Students will be able to construct a multi-attribute utility function Students will be able to implement the additive model for multi-attribute utility theory	P, R, CD FA, F / AO, IT, SI, CL-I	CE, AE, AC, RO	AP, AN / A	**Homework discussion** ***HW #5 Due*** (Students will be able to construct a multi-attribute utility function Students will be able to implement the additive model for multi-attribute utility theory) ***Possible guest lecturer***	P, R, CD FA, F / AO, IT, SI	CE, AE, AC, RO	AP, AN / A	***Interactive Review of Course***

15 **12/4** To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario To identify and define any limitations of the models and techniques for rational decision-making To structure and solve complicated decision problems	R, I, CD, DP, LD, LI F, D / IT, SI, CL-I, CL-F, STI, GI	CE, AE, AC, RO	KR, CU, AP, AN, SE, EC / A	***Performance Task #3 – Phase 4: Improve and Control must be completed*** (Students will be able to recommend a course of action based on the original solution Students will be able to assess the usefulness of the solution and recommend any changes in the process To identify and define any limitations of the models and techniques for rational decision-making.) ***Project Presentations*** (To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario)	R, I, CD, DP, LD, LI F, D / IT, SI, CL-I, CL-F, STI, GI	CE, AE, AC, RO	KR, CU, AP, AN, SE, EC / A	***Project Presentations*** (To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario)

16-2/11 **FE** To learn to use a specific set of analytical tools for technical decision making under uncertainty. To apply analytic decision making techniques for technical decision making under uncertainty, and to analyze and evaluate the results. To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario To identify and define any limitations of the models and techniques for rational decision-making To structure and solve complicated decision problems	P FA / IT, SI, DEDUCTIVE	AE, AC, RO	KR, AP, AN / A	***Final Exam*** (To learn to use a specific set of analytical tools for technical decision making under uncertainty. To apply analytic decision making techniques for technical decision making under uncertainty, and to analyze and evaluate the results.)	R, I, CD, DP, LD, LI F, D / IT, SI, CL-I, CL-F, STI, GI	AE, AC, RO	KR, CU, AP, AN, SE, EC / A	**Performance Task #3 – Final Written Reports Due** (To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario To identify and define any limitations of the models and techniques for rational decision-making To structure and solve complicated decision problems)

DISCUSSION OF PROFESSORS' 2005 AND 2006 TEST AND TEST ANALYSIS COMPARISONS

Jerry Gilmer, Ph.D.

Each professor submitted copies of the midterm and final exams they used in their classes during the Fall 2005 semester and the corresponding exams they used during the Fall 2006 semester. The Fall 2006 exams were developed during and after formal training in test development; it is expected that the 2006 exams would be improved over the 2005 exams. The professors also learned formal item analysis procedures and generated item analyses for their exams from both Fall 2005 and Fall 2006 semesters.

The professors' exams and the item analysis results were compared and some general comments from the comparisons are included below. During the test development training, professors learned about different characteristics of good exams, and it is these characteristics that were used for making comparisons from 2005 to 2006. Characteristics of item analysis were also presented to the professors and considered for comparisons.

The discussion below includes a brief statement regarding the meaning of each characteristic and then a brief evaluation related to the changes in tests and item analyses from 2005 to 2006. The characteristics were applied for evaluation to each of the exams and analyses submitted by each professor.

Test Characteristics

Based on Item Bank – Is the exam based on an item bank – a pool of items? During the test development sessions professors were asked to develop an item bank covering all of the content areas in their course.

> **Evaluation –** It appears that *none* of the exams for 2005 were based on an item bank and that *all* of the exams for 2006 were based on an item bank.

Based on Table of Specifications – Is the exam based on a formal plan, a blueprint, also called a table of specifications? The professors were taught how to create and utilize a table of specifications to ensure the test covers all the intended material in appropriate/specified proportions.

> **Evaluation –** It appears that *none* of the exams for 2005 were based on a table of specifications and that *all* of the exams for 2006 were based on a table of specifications.

Overall Appearance – well laid out; pleasing appearance, grammar, etc. **–** The exam should be generally pleasing to look at and easy to read and follow. Characteristics such as font selection, spacing, use of highlights such as indents, bold letters, etc. should be considered.

> **Evaluation –** The 2006 exams were *much improved* over the 2005 exams for six of the seven professors. In general appearance, the 2006 exams from one professor looked similar to the 2005 exams.

Overall Instructions – clear, unambiguous – The exam should include some overall instructions to the students, and these instruction should appear on the first page of the exam.

Evaluation – Four professors included *very good and improved* instructions for their 2006 exams. Two instructors did not provide any overall instructions, and one professor modified the instructions only slightly.

Instructions for Item Subsets – clear unambiguous – Sometimes instructions are necessary for item sets – a group of multiple choice items, or a group of short-answer items, for example, or a set of items related to a common diagram or a common reading passage.

Evaluation – Four of the professors included item sets, and their instructions for these sets for 2006 were *generally very good*. Three of the professors did not use item sets.

Number of short, discrete items vs. longer items – The test development sessions covered the use of more short, discrete items rather than fewer longer items to ensure that the exam provides an adequate sampling of the course material.

Evaluation – All of the 2006 exams were *improved* on this characteristic. Most professors used long, problem-type items for their 2005 exams but converted to more discrete items for their 2006 exams. Two professors added only a small number of discrete items and still used few, problem-type items.

Number of objectively scored vs. subjectively scored items – Although subjectively scored items (short- or long-answer, problem-type, requiring scorer judgments) are sometimes appropriate, the use of objectively scored items (multiple choice, true-false, etc.) is often preferred. They are easier and more efficient to score, and generally yield a more reliable exam.

Evaluation – All professors, along with using more short, discrete, items, used items that could be objectively scored. Most professors included a few subjectively scored items as well. Two professors used only subjectively scored items on the final exam; one of those did so after discussing the midterm with the class and determining that subjectively scored items were more appropriate to the course content.

Item Quality – clear, direct, well written, no clues – The items should be well-written, using appropriate English, and should contain no clues or cues.

Evaluation – This characteristic is difficult for a non-expert in the content to judge, but generally the exams appeared to be clear and understandable. For two professors, the 2006 exams seemed to exhibit no changes. For the other five professors, the 2006 exams exhibited noticeable improvement. But the 2005 exams appeared to be satisfactory to begin with.

Item Analysis Characteristics

Item Difficulty – number of very difficult items – In general, the items should not be too difficult. If less that 50% of possible points for an item were awarded, the item was judged to be too difficult. This threshold (50%) is not inappropriate and was used consistently to evaluate the exams and item analyses submitted by the professors. But the professors were informed that they should determine their own threshold, one that is meaningful to them and their exams and that there is no specific value that should be used for judging items in all situations.

Evaluation – Some professors' 2005 exams contained a small number of problems, and these problems had generally high (easy) difficulty indices. All the analyses for the 2006 exam analyzed several more items. It appeared that more items were flagged as being too

difficult (difficulty index less than 50%) than would normally be desired. New item types were being used for the first time by most of the professors, and they are still learning how to use item analysis data to improve item performance for future administrations.

Item Discrimination – number of poorly discriminating items – In general the items should discriminate between students proficient in the content and students who are less proficient. Items were flagged if the discrimination index was less than 0.15. This threshold is not completely arbitrary, but as with the difficulty index, professors were counseled to choose a threshold that is meaningful and appropriate for their context. Professors were also informed, however, that an item should not have a negative discrimination index.

Evaluation – For the 2006 exams, there were probably more poorly discriminating and negative discriminating items than would be desired. As indicated above, however, new item types were being used for the first time by most of the professors, and they are still learning how to use item analysis data to improve item performance for future administrations.

Table B.9.a.1: 2005 vs. 2006 Test and Test Analysis Comparisons – Ibrahim Abdel-Motaleb

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	
Based on Table of Specifications	No	Yes	No	
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	OK. Test is only one item, 3 parts, 20 pts.	Very good! 33 Items.	Take home exam. One item, 3 parts, 50 pts.	
Overall Instructions - clear, unambiguous	Not really there. Only one item.	Not much there.	Instructions may be satisfactory. But pt values for items & overall test not specified.	
Instructions for Item Subsets - clear, unambiguous	NA	Yes. Some for matching and others.	NA	
Number of short, discrete items vs longer items	One long item - 20 pts.	Test contains mostly short, discrete items rather than a single long item.	One long item, 3 parts, 50 pts.	
Number of objectively scored vs subjectively scored items	Item is subjectively scored. No scoring criteria provided to students.	Several MC items (objectively scored) and short answer items (subjectively scored).	Subjectively scored. No scoring criteria provided.	
Item Quality - clear, direct, well written, no clues	Appears OK.	Appears OK.	Appears OK.	
Item Analysis Comparisons	One item, 3 parts, 20 pts.	33 items but only 20 in item analysis (?)	One item, 3 parts, 50 pts	
Item Difficulty - number of very difficult items	diff - 67%, the 3 parts not analyzed separately.	Diff: 16 items > 50% 4 items < 50%	Lowest diff = 72%. Overall test average = 77%	
Item Discrimination - number of poorly discriminating items	Can't compute since analyzed as one item, not for three parts.	Disc: 2 items 0.0-.15 1 item negative.	Lowest disc = .69. But high disc expected since only 3 parts.	

Table B.9.a.2: 2005 vs. 2006 Test and Test Analysis Comparisons – Abul Azad

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Generally good. Tests called First In-course Exam and Second In-course Exam. Total of 18 items.	About the same as F05; called Midterm. Total of 12 items.	Generally good. Only 8 items.	Similar to F05. 7 items (last item mislabeled as #8) 10 parts: 1a, 1b, 1c, etc.
Overall Instructions - clear, unambiguous	No overall test instructions.	No overall test instructions.	No overall test instructions.	No overall test instructions.
Instructions for Item Subsets - clear, unambiguous	NA	NA	NA	NA
Number of short, discrete items vs longer items	Combination of short-answer and longer-answer items. But items have multiple parts (1a, 1b, 1c, etc.	Fewer short- and long-answer items. Five MC items.	Most items appear to be longer, problem-type; remainder are short-answer. Some with multiple parts (1a, 1b, 1c).	All items are short- or long-answer type
Number of objectively scored vs subjectively scored items	All items appear subjectively scored.	Five of the twelve items are objectively scored.	All are subjectively scored.	All are subjectively scored.
Item Quality - clear, direct, well written, no clues	Items appear clear and direct.	Items appear clear and direct.	Items appear clear and direct.	Items appear clear and direct.
Item Analysis Comparisons	First 2 tests - 18 items = 200 pts; 12 items & 6 items	12 items = 100 pts.	8 items - 100 pts.	10 items/parts analyzed 100 pts.
Item Difficulty - number of very difficult items	14 of 18 items analyzed. All items were very easy: smallest diff = 72%.	1 diff = 20%	Very easy - smallest diff = 70%.	Lowest diff = 54% Others 61%-81%
Item Discrimination - number of poorly discriminating items	3 items had negative discrimination indices - partly because they were so easy and high scorers got them wrong.	4 items disc in 0.0-.15. 1 item negative disc.	2 items with disc <.10 No negative discriminators.	Lowest disc = .44 Others .71-.94

Table B.9.a.3: 2005 vs. 2006 Test and Test Analysis Comparisons – Brianno Coller

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Not really a midterm; just quizzes #3, #4 and #5. 15 pts and 2 problems each quiz. Total 45 pts.	Great looking exam! 34 items, 36 pts. Pts. specified for each item.	Doesn't really have the formal appearance of an exam. 4 problems, 15 pts each = 60 pts.	Great looking exam! 33 items, 33 pts. Pts. specified for each item.
Overall Instructions - clear, unambiguous	NA	Great - Comprehensive	None	Good
Instructions for Item Subsets - clear, unambiguous	NA	Very clear	NA	Very clear
Number of short, discrete items vs longer items	4 short-answer problems, 2 MC	All are short, discrete items	4 long problems.	All are short, discrete items
Number of objectively scored vs subjectively scored items	Only 2 items objectively scored.	All are objectively scored	All subjectively scored.	All are objectively scored
Item Quality - clear, direct, well written, no clues	OK	Very good	OK	Very good
Item Analysis Comparisons	Each quiz analyzed separately - not combined, 2 problems each.	34 items analyzed	4 problems analyzed	33 items analyzed
Item Difficulty - number of very difficult items	1 (of 6) diff <50% Quiz means are 61%, 52% and 42%	14 items diff < 50% Test mean = 55%	1 problem diff =50% Test mean = 58%	9 items diff < 50% Test mean = 59%
Item Discrimination - number of poorly discriminating items	Al 6 disc >.56	2 items disc 0.0-.15	All 4 disc >.58	3 items disc 0.0-.15 1 item disc negative

Table B.9.a.4: 2005 vs. 2006 Test and Test Analysis Comparisons – Abhijit Gupta

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Not much here. 3 problems. Slightly difficult to read. Poor photocopy?	A much better-looking exam than F05.	Could be better. Only 4 items. Poor photocopy.	Much improved appearance over F05.
Overall Instructions - clear, unambiguous	OK	Good. Includes pt. values for each item.	OK	Good, with pt values for each item.
Instructions for Item Subsets - clear, unambiguous	NA	Yes, good.	NA	Very good!
Number of short, discrete items vs longer items	All 3 items are long problem type.	All but 3 items are MC, TF. 41 total items.	All 4 are long problem type.	All but 4 items are MC, TF. 30 total items.
Number of objectively scored vs subjectively scored items	All subjectively scored.	All but 3 are objectively scored.	All subjectively scored.	26 items are objectively scored.
Item Quality - clear, direct, well written, no clues	Probably OK.	Very good.	OK	Very good!
Item Analysis Comparisons	3 items	41 items analyzed	4 items	30 items analyzed
Item Difficulty - number of very difficult items	Lowest diff = 53% Test mean = 67%	22 items with diff <50%. Test mean = 43%. Hard test!	Lowest diff=44% Test mean = 67%	7 items with diff <50% Test mean = 60% Not as hard as midterm.
Item Discrimination - number of poorly discriminating items	All disc good (>.50) Expected, with only 3 items.	8 items disc 0.0-.15 3 items negative disc	1 item disc =.17, others >.60	2 items disc 0.0-.15 3 items negative disc.

Table B.9.a.5: 2005 vs. 2006 Test and Test Analysis Comparisons – Reinaldo Moraga

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	OK Take home? Only 2 problems, 100 pts.	Great looking exam. 25 items, 100 pts.	OK 6 problems. 5 from textbook, 100 pts. Take home?	Part 1: 3 long problems from text = 100 pts. Part 2: Great looking exam. 25 items, 25 pts.
Overall Instructions - clear, unambiguous	OK	Good. More comprehensive	OK	Good for part 2
Instructions for Item Subsets - clear, unambiguous	NA	NA	NA	NA
Number of short, discrete items vs longer items	Both are long problems.	All items are short, discrete.	All are long problems.	25 items in part 2 are short, discrete.
Number of objectively scored vs subjectively scored items	Subjectively scored.	All are MC items.	Subjectively scored.	3 in part 1 are subjectively scored. 25 in part 2 are all MC.
Item Quality - clear, direct, well written, no clues	OK	Appears clear and direct.	OK	Good.
Item Analysis Comparisons	2 items analyzed	25 items analyzed	6 items analyzed	28 items analyzed
Item Difficulty - number of very difficult items	Both diff around 48%	7 items diff < 50% Test mean = 55% (Hard test)	All diff > 65%	9 items diff < 50% Test mean = 60%
Item Discrimination - number of poorly discriminating items	Both disc around .84	1 item disc 0.0-.15 (a very easy item) 1 item negative disc.	All disc > .46	4 items disc 0.0-.15 6 items disc negative

Table B.9.a.6: 2005 vs. 2006 Test and Test Analysis Comparisons – Regina Rahn

	Midterm		Final	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Good 5 items with multiple parts. Total of 13 items/parts.	Great 30 items, 100 pts.	Good 6 items with multiple parts. (Take home?) Total of 19 items/parts	Good. 17 items, 105 pts.
Overall Instructions - clear, unambiguous	No overall test instructions	No overall test instructions	No overall test instructions	No overall test instructions
Instructions for Item Subsets - clear, unambiguous	Good	Good	Good	Good. 17 items, 105 pts.
Number of short, discrete items vs longer items	Most are problem-type. Some may be short-answer.	5 short answer 25 MC, TF, Matching	Most are problem-type. Some may be short-answer.	Most are short answer, remainder are longer answer.
Number of objectively scored vs subjectively scored items	All are subjectively scored.	5 subjectively scored 25 objectively scored	All are subjectively scored.	All are subjectively scored.
Item Quality - clear, direct, well written, no clues	Good	Good	Good	Good
Item Analysis Comparisons	13 items/parts analyzed	30 items analyzed	6 items analyzed- <u>not</u> by parts.	17 items analyzed
Item Difficulty - number of very difficult items	2 items diff <50% Test mean = 70%	3 items diff < 50% Test mean = 78%	All diff >73% Test mean = 82%	All items diff > 50% Test mean = 78%
Item Discrimination - number of poorly discriminating items	1 disc < .15 (=.07)	5 items disc 0.0-.15 2 items disc negative	1 disc <.15 (=.06) (1 high scorer did poorly on this item.)	1 item disc 0.0-.15 3 items disc negative

Table B.9.a.7: 2005 vs. 2006 Test and Test Analysis Comparisons – Robert Tatara

	Midterm		**Final**	
Test Comparisons	**Fall 2005**	**Fall 2006**	**Fall 2005**	**Fall 2006**
Based on Item Bank	No	Yes	No	Yes
Based on Table of Specifications	No	Yes	No	Yes
Overall Appearance - well laid out; pleasing appearance, grammar, etc.	Courier font. 25 items = 100 pts.	Bigger, more attractive font. Better overall appearance. 30 items = 30 pts.	Courier font. Layout and appearance OK. 35 items = 100 pts.	Better overall appearance. Better font
Overall Instructions - clear, unambiguous	Generally OK	Much better, clearer, more complete.	OK	Much better, clearer, more complete.
Instructions for Item Subsets - clear, unambiguous	NA	NA	NA	NA
Number of short, discrete items vs longer items	Some items are longer, problem type. Some are short answer.	No long problem-type. Fewer short answer, More are MC, TF, matching.	Several short-answer. Some longer problem-type. Not quite half are MC, TF, etc.	No long problem-type. Fewer short answer, More are MC, TF, matching.
Number of objectively scored vs subjectively scored items	Most are subjectively scored. Small number are objectively scored	Most are objectively scored - MC, TF, matching. Very few are short answer, subjectively scored.	19 subjectively scored. 16 objectively scored - MC, TF, etc.	Most are objectively scored - MC, TF, matching. Very few are short answer, subjectively scored.
Item Quality - clear, direct, well written, no clues	Perhaps some slight ambiguities -- but mostly clear and direct.	Appears clear and direct	Generally good.	Appears clear and direct
Item Analysis Comparisons	25 items analyzed	30 items analyzed	35 items analyzed	50 items analyzed
Item Difficulty - number of very difficult items	7 items (39%) diff < 50% Test mean = 66%	9 items (43%) diff < 50% Test mean 62%	4 items (13%) diff < 50% Test mean 74%	10 items (20%) diff < 50% Test mean 72%
Item Discrimination - number of poorly discriminating items	1 item disc negative	5 items disc 0.0-.15 4 items disc negative	10 items disc 0.0-.15 2 items disc negative	8 items disc 0.0-.15 4 items disc negative

PERFORMANCE TASK AND RUBRIC DEVELOPMENT ASSESSMENT
Jule Dee Scarborough, Ph.D.

The learning and professional growth on the Performance Assessment program or knowledge component was measured by the professors' performance on the task of designing and developing three complex performance tasks and three corresponding rubrics for scoring task achievement. Using the Rubrics below as guiding criteria, they each designed three complex performance tasks and corresponding rubrics. These assessments were added to their course a new assessment strategy and assessment procedures.

It is important to note that one performance task/rubric was designed to correspond with the midterm, and another to correspond with the final exam using the logic that objective tests usually reflect what students know or know about rather than what they can do. Therefore, we used an unusual scenario where the professors "linked" the objective midterm exam to a midterm performance task/rubric as well as an objective final exam to a final performance task/rubric. They also developed a third performance task/rubric and choose how and when to use it. They were asked to "match" where they thought the test items and performances "overlapped" and measured the same or similar content. It was assumed from studying the literature that performance assessment measures different aspects of learning, sometimes deeper levels of learning through use of knowledge in more active or engaging ways, problems, projects, etc. But performance assessment can also measure some of the same aspects of learning as objective tests. Also some of the professors designed their tests to incorporate some level of performance in subjective or problem based items. In examining the tests and analyzing them, the objective items were separated from the more performance based items.

Professors were provided a presentation about Performance Assessment. Performance Tasks and Rubrics were discussed, and they received a portfolio of sample tasks and rubrics. They were given books on the topic as part of their new library on teaching and learning. Their performance tasks and rubrics reflect the ABET or NAIT standards with corresponding rubrics. Perhaps one professor had used simple and less formalized rubrics before, but none of the professors had developed or used formal, written, scenario-based performance tasks with corresponding rubrics before this initiative. Thus, there were no previous instruments to view from the baseline semester, Fall 2005, and compare to these. Therefore, we judged them based upon the Rubrics below.

Performance Task: Design and develop three complex performance tasks with corresponding rubrics. The tasks must be based upon the ABET outcomes or NAIT standards and corresponding student learning outcomes for the coure; they must also reflect real world, authentic performances, tasks, or behaviors in the appropriate community of practice, e.g. industry. The performance tasks and rubrics must be used to measure student learning in the experimental research course, Fall 2006. See the **Rubrics** below for the achievement criteria to use in accomplishing the task.

Performance: The professors accomplished the performance task well. The process involved drafting initial and authentic real world scenarios with embedded task clusters and a corresponding rubric instrument for each task (3). The program leader provided feedback one-on-one as the performance tasks were developed. The professors shared their drafts with each other and benefited from the group critique process. The group process worked especially well. The tasks and rubrics were finalized; the program leader approved them; and then, each professor used the tasks and corresponding rubrics successfully with students during the 2006 experimental research semester. After the semester was completed, the professors copied all rubrics returned to each student in their classes for all three performance tasks. The program leader reviewed the scored/with comments rubrics that each student received back from the professors. Thus, the use of the rubrics was also reviewed. Finally, the professors completed a feedback/evaluation form about the use of performance assessment for the first time. As with test analysis and development, the feedback from the professors on the value of learning to design, develop, and use performance tasks/rubrics was extremely positive.

The following rubrics were used to guide the professors in the development of the three performance tasks and corresponding rubrics for each task.

Also, the feedback and evaluation questionnaire and professor responses are provided below, following the rubrics. The faculty members truly felt that expanding their assessments to include performance tasks with rubrics was extremely positive. They all indicated that they will continue to use performance assessment, tasks and rubrics, and also expand the use of performance assessment to other courses.

Responses to the feedback and evaluation related to Performance Assessment follows the rubrics below.

Rubric for Assessing the Quality of a Performance Task

Key Components - Properly Designed Performance Tasks must

- **I. Be based on content standards established by ABET or NAIT**
- **II. Describe a "real-life" scenario; are real world, authentic tasks; require active performances**
- **III. Involve students in complex reasoning – critical thinking at upper levels of Bloom's Cognitive Dimension**
- **IV. Require students to collect and process information, using it for an authentic purpose**
- **V. Incorporate "habits of mind"**
- **VI. Require student collaboration and cooperation; incorporates "individual" and "group" learning and performance accountability**
- **VII. Result in a tangible product and/or communication activity**

For each component, there are descriptors reflecting levels of achievement possible:

I. The Performance Task is based on the ABET or NAIT standards

a. The Performance Task is directly related to the ABET or NAIT standards.
b. Learning standards are apparent, but the relation to the task and/or national standards is sketchy or not apparent.
c. The Performance Task does not appear to be based on the standards/outcomes, course or national.

II. The Performance Task describes a "real-life" scenario that is authentic and requires active performance.

a. The scenario described in the task accurately mirrors an activity in the community of practice outside the classroom.
b. The scenario described in the task simulates an activity in the community of practice outside the classroom.
c. The scenario described in the task contains some aspects of activity outside the classroom but is largely contrived.
d. The scenario described in the task is an academic exercise that usually takes place only in the context of an academic setting.

III. The Performance Task involves students in complex reasoning-critical thinking processes at upper levels of Bloom's Cognitive Dimension.

a. The task requires students to utilize complex reasoning – critical thinking skills, such as induction/deduction, diagnosis, abstracting, experimental inquiry, problem solving; evaluation, creation, synthesis, etc.
b. The task requires students to utilize complex reasoning components, such as comparing, classifying, decision making, or investigation.
c. The task requires students only to recall facts.

IV. The Performance Task requires students to collect and process information, using it for an authentic purpose.

a. The task incorporates a variety of information gathering techniques and information resources. Students are required to interpret and synthesize information and accurately assess the value of information gathered. They are required to collect the right information for an authentic purpose, e.g. solve a problem, apply or use in a complex project, etc.
b. The task requires students to gather and synthesize information, but the value of the information gathered is not assessed. Information may not be used for a purpose.
c. The task requires the students to gather information, but not to interpret it.
d. The task requires no gathering or processing of information.

V. The Performance Task incorporates "Habits of Mind."

a. The task requires students to make effective plans, use necessary resources, evaluate effectiveness of their own actions, seek accuracy, and engage in activities when answers or solutions are not immediately apparent.
b. The task only requires students to effectively plan or use resources.
c. The task does not require students to engage in self-regulation, critical, or creative thinking.

VI. The Performance Task requires student collaboration and cooperation; incorporates "individual" and "group" learning and performance accountability.

a. The task requires students to use interpersonal skills, work toward the achievement of team goals, and perform a variety of roles within the team. There is a formal team structure and process.
b. The task requires students to work together in teams but there are no measures described that ensure collaboration or cooperation among team members.
c. The task is completed largely by students on an individual basis rather than in student teams.

VII. The Performance Task results in a tangible product and/or communication activity.

a. The task result is a tangible product or communication activity comparable to that commonly produced in business or industry community of practice.
b. The task results in a product that is similar to those completed in business or industry community of practice, but lacks several components that make the product realistic.
c. The task does not result in a product or communication activity relevant to a business or industry community of practice.

(Scarborough, 2006 [Based upon White & Scarborough, 2004])

Rubric for Assessing the Quality of a Rubric

Properly Designed Rubrics Must

- **I. Contain a set of key components/standards to be assessed that reflect the student learning outcomes for the course, which are directly linked to the national outcomes.**
- **II. Include descriptors for each component/standard that are measurable.**
- **III. Have descriptors-criteria that are indicative of observable student performances or behaviors.**
- **IV. Incorporate a clear and well-defined scoring system**
- **V. (Optional) Include appropriate weights for each component and descriptor**

For each component, there are descriptors reflecting levels of achievement possible:

I. The rubric contains a set of key components (standards) to be assessed.

a. A complete list of key components-standards is provided for the performance task, including the embedded subtasks, if a cluster. The task(s) are directly connected to student learning outcomes for course and the national outcomes.
b. Key components/standards listed are not exhaustive for the performance task and/or subtasks embedded are not clear enough for student response or action; components or standards are not clearly connected to student learning outcomes for course.
c. Not all key components/standards describe student outcomes; some are not directly linked to national outcomes.
d. No key components are listed.

II. The rubric includes a set of descriptors-criteria for each key component or standard.

a. Descriptors-criteria for each component or standard are arranged in a clear hierarchy from non-achievement to full-achievement.
b. Descriptors-criteria are present for each component/standard, but obvious levels in some are missing.
c. Each component does not have an associated set of descriptors-criteria.

III. The rubric descriptors/criteria are clear and contain observable or measurable student performances or behaviors.

a. All descriptors-criteria clearly delineate levels of observable student performances or behaviors.
b. Most descriptors-criteria clearly delineate levels of observable student performances or behaviors.
c. Only a few descriptors-criteria clearly define levels of observable student performances or behaviors.
d. Descriptors-criteria do not describe observable student performances or behaviors.

IV. **Incorporate a clear and well-defined scoring system**

a. There is a well defined and clear system for scoring each component-standard and its descriptors- criteria. Points or percentages are assigned appropriate to instructional and performance values.
b. The scoring system lacks definition, clarity, and although there is a scoring system, some aspects are ambiguous, subjective or unclear.
c. There is no scoring system.

V. Optional: Appropriate weights are assigned to components and descriptors.

a. Component-standards and descriptors-criteria are each properly weighted according to instructional emphasis and performance values.
b. Weights are assigned, but point values do not reflect proper instructional emphasis and performance values in all cases.
c. Weights are assigned to some performance standards and descriptors, but not others.

(Scarborough, 2006 [Based upon White & Scarborough, 2004])

CEET Initiative on Teaching and Learning - Performance Assessment Feedback, Jan, 2007
(7/7 respondents)

1. Was the time spent developing <u>performance</u> <u>tasks</u> worth your time – worthwhile?

(7) Yes Not really

Why?

- *"A lot of work, but they really engage students"*
- *"Allowed me to think about what students should be able to perform after completing the course."*
- *"Invaluable." "Although I always give 'projects', I was naïve to many of the aspects of a true performance task."*
- *"Performance tasks made students (1) solve open ended problems; (2) work in groups; (3) identify problems and try to have multiple solutions and then justify the solution."*

2. Was the time spent developing <u>rubrics</u> for scoring the performance tasks worth your time – worthwhile?

(7) Yes Not really

Why?

- *"Students knew what was expected of them; grading was a bit easier; fewer students challenged their grades."*
- *"Allowed me to set expectations from the PAs."*
- *"The students really responded well to them! They liked knowing the expectations for performance tasks."*
- *"I didn't have this experience before."*
- *"Rubrics helped students understand what is expected of them and how they will be graded."*

3. Would you <u>recommend</u> the <u>performance task</u> program content for other faculty members?

(7) Yes Not really

Why?

- *"Valuable"*
  "It will be a good exercise for others."
- *"I think any new faculty should be exposed to this experience."*
- *"I feel students learned a lot because of the performance tasks."*

4. Would you <u>recommend</u> the <u>rubric</u> program content for other faculty members?

(7) Yes Not really

Why?

- *"It will be a good exercise for others."*
- *"This, I believe, is a necessity."*

5. Were the <u>performance</u> <u>tasks</u> a <u>beneficial</u> addition to the student assessment plan for your course?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
  "Provides additional form of assessment method."
- *"It added a new dimension of student assessment; also these performances tasks involved various learning styles."*

6. Were the <u>rubrics</u> <u>beneficial</u> for scoring the performance tasks?

(7) Yes Not really

Why?

- *"Students knew what was expected of them; grading was a bit easier; fewer students challenged their grades."*
- *"Makes the scoring process easier."*
- *"It made it easier for me – and the students also responded well. IT is necessary to have a procedure mapped out for them to understand the expectations and levels."*
- *"They make grading progress easier."*
- *"Otherwise, it would be very subjective or arbitrary."*

7. Were the <u>performance</u> <u>tasks</u> an <u>effective</u> tool for <u>enhancing</u> student learning?

(7) Yes Not really

Why?

- *"Bigger, more authentic tasks."*
- *"Students can demonstrate what they can perform after completing the course."*
- *"(1)It allowed for many more teaching styles to be incorporated in the course; (2) more learning styles were also included; (3) a good tool for group work as well."*
- *"They really understand expectations."*
- *"Students' learning involves various learning and teaching style, and models and performance tasks provided these opportunities."*

8. Were the <u>performance</u> <u>tasks</u> an effective tool for <u>measuring</u> student learning?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Students can demonstrate what they can perform after completing the course."*
- *"(1) It demonstrated their abilities to communicate effectively; (2) It demonstrated their abilities to synthesize, apply, and evaluate subject matter content."*
- *"Students' learning may not be completely assessed by only exams and homework."*

9. Were the <u>rubrics</u> an <u>effective</u> tool for <u>scoring</u> the outcomes of student performances on the tasks?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"See previous comments."*
- *"Rubrics provide the details of expected outcomes."*

10. Were the <u>rubrics</u> <u>effective</u> in helping students to <u>understand</u> <u>more</u> about what you expected them to do by revealing the standards and scoring mechanism with them up front?

(7) Yes Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Students know the expectations."*
- *"See previous comments."*
- *"They know what is expected of them."*

11. Do you feel that more <u>formalized</u> <u>performance</u> <u>tasks</u> and rubrics <u>improve</u> the opportunity for students to provide <u>evidence</u> of learning?

(6) Yes (1) Not really

Why?

- *"It was another dimension of assessment. Some students who did not do well on tests…really shined in performance."*
- *"Not everyone is good in taking tests. Also exams and homework do not provide the opportunity through performance tasks."*
- *"Two is enough."*

12. Would you <u>recommend</u> that other faculty members get the opportunity to learn to develop and use performance tasks and rubrics as student assessment tools?

(7) Yes Not really

Why?

- *"I believe this was one of the <u>most</u> beneficial aspects of the program with regard to student learning and assessment. It ties in with active learning and Bloom's Taxonomy."*
- *"It was a big help for me."*

13. Was the performance/rubric development process used with this group – *"developing while learning from presentation, examples, and one-on-one feedback"* - effective?

(7) Yes Not really

Why?

- *"One-on-one feedback especially helpful."*

14. Will you <u>continue</u> to use <u>performance</u> <u>tasks</u> and <u>rubrics</u> in this and/or other classes?

(7) Yes Not really

Why?

- *"To improve student learning."*

15. Strengths of the performance task/rubric program component.

- *"Already stated in above [responses]."*
- *"Measures what students can really perform with their learned tools."*
- *"Quantified student performance; gave students guidance and goals."*
- *"I liked the development of the Performance Tasks, especially with the rubric. Discussions were enlightening, as well as our group discussions and evaluations."*
- *"Very good way in presenting material; Different styles of rubrics presented; also working in our same classes helped to learn how to do rubrics and performances."*
- *"Provide other teaching styles, learning styles, and teaching models."*
- *"Allow for active learning. Results show improvement when Performance Tasks were done in groups."*

16. Areas to improve in the performance task/rubric program component.

- *"Revisit and revise."*
- *"None."*
- *"Streamline the time scale."*
- *"Good as is."*

17. General comments:

- *"This part was exceptional—I will always use this info in my classes in the future."*
- *"Very good program."*
- *"Results indicate conclusively that learning level was enhanced [by students in experimental semester]."*

MIDTERM AND FINAL EXAM → PERFORMANCE ASSESSMENT CORRELATION[1]

JULE DEE SCARBOROUGH, PH.D. AND JERRY GILMER, PH.D.

Typically, traditional objective tests are only indicators of what students can do with the knowledge being measured. Performing well on a traditional test should not lead to an assumption of what a student can do with that knowledge (e.g., how well they can use the knowledge). Traditional or objective tests usually measure what students know or know about, while performance assessments engage students in performance tasks where they use the knowledge in some way. It is sometimes perceived by performance assessment advocates that performance assessments (if designed, developed, and well constructed) are better evidence of what students are capable of doing with knowledge gained. That is assuming that most traditional tests are written to measure memory for information, concepts, theories, facts. If, however, tests have been written to include items that are higher on Bloom's Taxonomy and require more critical thinking or problem solving, then those tests would provide evidence of something more than what students know about, as the particular items engaging students in higher levels of critical thinking and problems solving usually require that students provide evidence of what they know about by using that knowledge to solve the problem. That is, if the problems are complex and well constructed, use of the knowledge will provide evidence of learning.

Some prefer to use tests intentionally as indicators of what students know about and then follow those tests with performance tasks requiring students to solve problems or engage in projects that require critical thinking, the manipulation of facts, theories, concepts, and/or information in a context where particular constraints and conditions as well as tools, procedures, etc. are set. If this is the goal, then a test and performance task(s) may be designed to include measurement of some of the same content while also measuring some different content, as they are distinctly different types of measures with the potential to accomplish different measurement goals as well as some of the same goals. Therefore, we asked the professors to design and develop an objective midterm and final examination as well as corresponding performance task(s) "and scoring rubrics matching" the content where possible or desirable. The professors were also asked to identify the objective test items they felt were also being measured on the corresponding performance task(s).

A statistical correlation was run between the midterm exam and corresponding performance assessment and the final exam and corresponding performance examination for each professor's students. The results should lead the professors to consider the following:

1. Do they really feel that there is a segment of the objective tests and the performance tasks where there is a content match? If so, in our program, no external contentvalidation was required. We assumed the professors knew

[1] *Note: Correlations have been computed in two ways: 1) leaving zero scores in as zeros; 2) replacing zero scores with blanks or taking them out, e.g. student was absent.*

their content. However, it is key to note that it is important for professors using any measurement procedure or tool to validate content, procedures, etc. externally in the purest sense of measurement or student assessment. That, however, takes more time to execute with a faculty learning community and, in our opinion, would be part of a Stage II faculty development program. Our focus was on test analysis, writing better objective tests as well as better and higher level items to include problem solving items. In addition, our program focused on introducing them to the design, development, and use of performance tasks and rubrics as one type of learning measurement procedure or tool.

2. How are professors using the tests and performance task(s)? In our case, we encouraged them to design new tests with more items, a wider range of item types, and items that offer the opportunity to perform at various levels of Bloom's learning (e.g., memory to synthesis). We then asked them to design and develop corresponding performance tasks and rubrics to provide students the opportunity to provide evidence of learning through performances.
    a. Do they feel that the objective tests are indicators of what students know and the performance tasks take the students to the next level where they are positioned to more deeply or critically use the knowledge measured on the objective tests?
    b. Do they feel that they can better measure some types of knowledge with objective tests and other types of knowledge through performances?
    c. Other considerations

3. What might the correlation scores mean? How can they be used?
    a. The correlation scores might have no or little meaning.
    b. The scores might provide insight about students.
    c. The scores might stimulate diagnostic thoughts about student assessment.

Table B.9.c.1:

Professor = Ibrahim Abdel-Motaleb

Correlations(b) -- Including Zero Scores

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.(a)	0.263	.(a)	.(a)
	Sig. (2-tailed)		.	0.238	.	.
	N	24	0	22	0	0
Final	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.		.	.	.
	N	0	0	0	0	0
PA1	Pearson Correlation	0.263	.(a)	1	.(a)	.(a)
	Sig. (2-tailed)	0.238	.		.	.
	N	22	0	22	0	0
PA2	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.	.	.		.
	N	0	0	0	0	0
PA3	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.	.	.	.	
	N	0	0	0	0	0

a. Cannot be computed because at least one of the variables is constant.

b. Professor = Ibrahim Abdel-Motaleb

Correlations(b) -- With Blanks Replacing Zeros

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.(a)	0.263	.(a)	.(a)
	Sig. (2-tailed)		.	0.238	.	.
	N	24	0	22	0	0
Final	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.		.	.	.
	N	0	0	0	0	0
PA1	Pearson Correlation	0.263	.(a)	1	.(a)	.(a)
	Sig. (2-tailed)	0.238	.		.	.
	N	22	0	22	0	0
PA2	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.	.	.		.
	N	0	0	0	0	0
PA3	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	Sig. (2-tailed)	.	.	.	.	
	N	0	0	0	0	0

a. Cannot be computed because at least one of the variables is constant.

b. Professor = Ibrahim Abdel-Motaleb

Table B.9.c.2:

Professor = Abul Azad

Correlations(a) -- Including Zero Scores

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	0.388	.739(**)	0.509	.614(*)
	Sig. (2-tailed)		0.153	0.002	0.053	0.015
	N	15	15	15	15	15
Final	Pearson Correlation	0.388	1.000	.592(*)	0.430	.604(*)
	Sig. (2-tailed)	0.153		0.020	0.110	0.017
	N	15	15	15	15	15
PA1	Pearson Correlation	.739(**)	.592(*)	1	.526(*)	.922(**)
	Sig. (2-tailed)	0.002	0.020		0.044	0.000
	N	15	15	15	15	15
PA2	Pearson Correlation	0.509	0.430	.526(*)	1.000	0.410
	Sig. (2-tailed)	0.053	0.110	0.044		0.129
	N	15	15	15	15	15
PA3	Pearson Correlation	.614(*)	.604(*)	.922(**)	0.410	1.000
	Sig. (2-tailed)	0.015	0.017	0.000	0.129	
	N	15	15	15	15	15

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Professor = Abul Azad

Correlations(a) -- With Blanks Replacing Zeros

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	0.425	.739(**)	0.509	-0.114
	Sig. (2-tailed)		0.130	0.002	0.053	0.698
	N	15	14	15	15	14
Final	Pearson Correlation	0.425	1.000	.759(**)	0.327	0.483
	Sig. (2-tailed)	0.130		0.002	0.254	0.094
	N	14	14	14	14	13
PA1	Pearson Correlation	.739(**)	.759(**)	1	.526(*)	0.202
	Sig. (2-tailed)	0.002	0.002		0.044	0.489
	N	15	14	15	15	14
PA2	Pearson Correlation	0.509	0.327	.526(*)	1.000	0.061
	Sig. (2-tailed)	0.053	0.254	0.044		0.835
	N	15	14	15	15	14
PA3	Pearson Correlation	-0.114	0.483	0.202	0.061	1.000
	Sig. (2-tailed)	0.698	0.094	0.489	0.835	
	N	14	13	14	14	14

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Professor = Abul Azad

Table B.9.c.3:

Professor = Brianno Coller

Correlations(a) -- Including Zero Scores

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.610(**)	.390(**)	0.159	.320(**)
	Sig. (2-tailed)		0.000	0.000	0.165	0.004
	N	78	78	78	78	78
Final	Pearson Correlation	.610(**)	1.000	.414(**)	0.134	.805(**)
	Sig. (2-tailed)	0.000		0.000	0.242	0.000
	N	78	78	78	78	78
PA1	Pearson Correlation	.390(**)	.414(**)	1	0.156	.330(**)
	Sig. (2-tailed)	0.000	0.000		0.172	0.003
	N	78	78	78	78	78
PA2	Pearson Correlation	0.159	0.134	0.156	1.000	0.111
	Sig. (2-tailed)	0.165	0.242	0.172		0.333
	N	78	78	78	78	78
PA3	Pearson Correlation	.320(**)	.805(**)	.330(**)	0.111	1.000
	Sig. (2-tailed)	0.004	0.000	0.003	0.333	
	N	78	78	78	78	78

**. Correlation is significant at the 0.01 level (2-tailed).

a. Professor = Brianno Coller

Correlations(a) -- With Blanks Replacing Zeros

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.711(**)	.371(**)	0.159	.257(*)
	Sig. (2-tailed)		0.000	0.001	0.165	0.028
	N	78	71	76	78	73
Final	Pearson Correlation	.711(**)	1.000	.331(**)	0.075	0.168
	Sig. (2-tailed)	0.000		0.005	0.536	0.161
	N	71	71	70	71	71
PA1	Pearson Correlation	.371(**)	.331(**)	1	0.135	.318(**)
	Sig. (2-tailed)	0.001	0.005		0.245	0.006
	N	76	70	76	76	72
PA2	Pearson Correlation	0.159	0.075	0.135	1.000	0.131
	Sig. (2-tailed)	0.165	0.536	0.245		0.270
	N	78	71	76	78	73
PA3	Pearson Correlation	.257(*)	0.168	.318(**)	0.131	1.000
	Sig. (2-tailed)	0.028	0.161	0.006	0.270	
	N	73	71	72	73	73

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Professor = Brianno Coller

Table B.9.c.4:

Professor = Abhijit Gupta

Correlations(a) -- Including Zero Scores

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.544(**)	0.081	-0.056	-0.123
	Sig. (2-tailed)		0.000	0.602	0.716	0.425
	N	44	44	44	44	44
Final	Pearson Correlation	.544(**)	1.000	.304(*)	0.045	0.076
	Sig. (2-tailed)	0.000		0.045	0.773	0.626
	N	44	44	44	44	44
PA1	Pearson Correlation	0.081	.304(*)	1	-0.045	-0.073
	Sig. (2-tailed)	0.602	0.045		0.773	0.638
	N	44	44	44	44	44
PA2	Pearson Correlation	-0.056	0.045	-0.045	1.000	-0.003
	Sig. (2-tailed)	0.716	0.773	0.773		0.982
	N	44	44	44	44	44
PA3	Pearson Correlation	-0.123	0.076	-0.073	-0.003	1.000
	Sig. (2-tailed)	0.425	0.626	0.638	0.982	
	N	44	44	44	44	44

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Professor = Abhijit Gupta

Correlations(a) -- With Blanks Replacing Zeros

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.544(**)	0.081	-0.056	-0.123
	Sig. (2-tailed)		0.000	0.602	0.716	0.425
	N	44	44	44	44	44
Final	Pearson Correlation	.544(**)	1.000	.304(*)	0.045	0.076
	Sig. (2-tailed)	0.000		0.045	0.773	0.626
	N	44	44	44	44	44
PA1	Pearson Correlation	0.081	.304(*)	1	-0.045	-0.073
	Sig. (2-tailed)	0.602	0.045		0.773	0.638
	N	44	44	44	44	44
PA2	Pearson Correlation	-0.056	0.045	-0.045	1.000	-0.003
	Sig. (2-tailed)	0.716	0.773	0.773		0.982
	N	44	44	44	44	44
PA3	Pearson Correlation	-0.123	0.076	-0.073	-0.003	1.000
	Sig. (2-tailed)	0.425	0.626	0.638	0.982	
	N	44	44	44	44	44

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Professor = Abhijit Gupta

Table B.9.c.5:

Professor = Reinaldo Moraga

Correlations(a) -- Including Zero Scores

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.777(**)	.532(*)	0.178	0.130
	Sig. (2-tailed)		0.000	0.023	0.479	0.608
	N	18	18	18	18	18
Final	Pearson Correlation	.777(**)	1.000	0.149	0.293	0.110
	Sig. (2-tailed)	0.000		0.554	0.238	0.663
	N	18	18	18	18	18
PA1	Pearson Correlation	.532(*)	0.149	1	0.074	0.214
	Sig. (2-tailed)	0.023	0.554		0.771	0.395
	N	18	18	18	18	18
PA2	Pearson Correlation	0.178	0.293	0.074	1.000	.874(**)
	Sig. (2-tailed)	0.479	0.238	0.771		0.000
	N	18	18	18	18	18
PA3	Pearson Correlation	0.130	0.110	0.214	.874(**)	1.000
	Sig. (2-tailed)	0.608	0.663	0.395	0.000	
	N	18	18	18	18	18

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Professor = Reinaldo Moraga

Correlations(a) -- With Blanks Replacing Zeros

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.777(**)	.532(*)	0.186	-0.331
	Sig. (2-tailed)		0.000	0.023	0.490	0.194
	N	18	18	18	16	17
Final	Pearson Correlation	.777(**)	1.000	0.149	0.458	-0.241
	Sig. (2-tailed)	0.000		0.554	0.075	0.352
	N	18	18	18	16	17
PA1	Pearson Correlation	.532(*)	0.149	1	-0.177	-0.171
	Sig. (2-tailed)	0.023	0.554		0.511	0.511
	N	18	18	18	16	17
PA2	Pearson Correlation	0.186	0.458	-0.177	1.000	0.254
	Sig. (2-tailed)	0.490	0.075	0.511		0.343
	N	16	16	16	16	16
PA3	Pearson Correlation	-0.331	-0.241	-0.171	0.254	1.000
	Sig. (2-tailed)	0.194	0.352	0.511	0.343	
	N	17	17	17	16	17

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Professor = Reinaldo Moraga

Table B.9.c.6:

Professor = Regina Rahn

Correlations(a) -- Including Zero Scores

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.626(*)	0.510	.662(**)	.590(*)
	Sig. (2-tailed)		0.017	0.062	0.010	0.026
	N	14	14	14	14	14
Final	Pearson Correlation	.626(*)	1.000	.575(*)	.637(*)	.560(*)
	Sig. (2-tailed)	0.017		0.031	0.014	0.037
	N	14	14	14	14	14
PA1	Pearson Correlation	0.510	.575(*)	1	0.478	0.375
	Sig. (2-tailed)	0.062	0.031		0.084	0.186
	N	14	14	14	14	14
PA2	Pearson Correlation	.662(**)	.637(*)	0.478	1.000	.785(**)
	Sig. (2-tailed)	0.010	0.014	0.084		0.001
	N	14	14	14	14	14
PA3	Pearson Correlation	.590(*)	.560(*)	0.375	.785(**)	1.000
	Sig. (2-tailed)	0.026	0.037	0.186	0.001	
	N	14	14	14	14	14

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

a. Professor = Regina Rahn

Correlations(a) -- With Blanks Replacing Zeros

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.626(*)	0.510	.662(**)	.590(*)
	Sig. (2-tailed)		0.017	0.062	0.010	0.026
	N	14	14	14	14	14
Final	Pearson Correlation	.626(*)	1.000	.575(*)	.637(*)	.560(*)
	Sig. (2-tailed)	0.017		0.031	0.014	0.037
	N	14	14	14	14	14
PA1	Pearson Correlation	0.510	.575(*)	1	0.478	0.375
	Sig. (2-tailed)	0.062	0.031		0.084	0.186
	N	14	14	14	14	14
PA2	Pearson Correlation	.662(**)	.637(*)	0.478	1.000	.785(**)
	Sig. (2-tailed)	0.010	0.014	0.084		0.001
	N	14	14	14	14	14
PA3	Pearson Correlation	.590(*)	.560(*)	0.375	.785(**)	1.000
	Sig. (2-tailed)	0.026	0.037	0.186	0.001	
	N	14	14	14	14	14

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

a. Professor = Regina Rahn

Table B.9.c.7:

Professor = Robert Tatara

Correlations(a) -- Including Zero Scores

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.425(*)	-0.126	0.101	0.209
	Sig. (2-tailed)		0.024	0.524	0.608	0.285
	N	28	28	28	28	28
Final	Pearson Correlation	.425(*)	1.000	-0.099	.543(**)	.620(**)
	Sig. (2-tailed)	0.024		0.618	0.003	0.000
	N	28	28	28	28	28
PA1	Pearson Correlation	-0.126	-0.099	1	0.311	-0.003
	Sig. (2-tailed)	0.524	0.618		0.108	0.987
	N	28	28	28	28	28
PA2	Pearson Correlation	0.101	.543(**)	0.311	1.000	0.310
	Sig. (2-tailed)	0.608	0.003	0.108		0.109
	N	28	28	28	28	28
PA3	Pearson Correlation	0.209	.620(**)	-0.003	0.310	1.000
	Sig. (2-tailed)	0.285	0.000	0.987	0.109	
	N	28	28	28	28	28

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

a. Professor = Robert Tatara

Correlations(a) -- With Blanks Replacing Zeros

		Midterm	Final	PA1	PA2	PA3
Midterm	Pearson Correlation	1	.425(*)	-0.126	0.101	0.209
	Sig. (2-tailed)		0.024	0.524	0.608	0.285
	N	28	28	28	28	28
Final	Pearson Correlation	.425(*)	1.000	-0.099	.543(**)	.620(**)
	Sig. (2-tailed)	0.024		0.618	0.003	0.000
	N	28	28	28	28	28
PA1	Pearson Correlation	-0.126	-0.099	1	0.311	-0.003
	Sig. (2-tailed)	0.524	0.618		0.108	0.987
	N	28	28	28	28	28
PA2	Pearson Correlation	0.101	.543(**)	0.311	1.000	0.310
	Sig. (2-tailed)	0.608	0.003	0.108		0.109
	N	28	28	28	28	28
PA3	Pearson Correlation	0.209	.620(**)	-0.003	0.310	1.000
	Sig. (2-tailed)	0.285	0.000	0.987	0.109	
	N	28	28	28	28	28

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

a. Professor = Robert Tatara

DIAGNOSTIC WRITE UPS FROM TEST ANALYSES AND PERFORMANCE TASK/RUBRIC REVIEWS BY PROFESSORS
Jule Dee Scarborough, Ph.D.

The professors were asked to consider the results of the test analyses for the 2005 midterm and final exams, use the results as a diagnostic procedure by critically reflecting on the results of each analysis, and determine each test's strength and weaknesses. Finally, the professors were asked to identify changes that would improve the two tests. This "closed the loop"; in other words, they began to realize the ultimate purpose of performing test analysis – that of identifying and making changes to improve the quality and process of their testing and ultimately to improve instruction and student learning. This also served to provide a full circle of experience with test analysis and its diagnostic and change process, as they performed their initial test analyses on the Fall 2005 tests. For their first experience, if they could not use their own tests because of no objective items, then a real case was provided in place of their own for the Fall 2005 analysis. Using the diagnostic information generated by the analyses, they developed new midterm and final exams, following each with a test analysis and diagnostic write up.

After the professors implemented the newly developed performance assessments 1, 2, and 3, they were asked to also review and critically reflect upon their content and use. This provided another opportunity to engage in critical reflection (Reflective Practice) and for the first time on performance assessment. As they had never used performance assessments and rubrics as an assessment procedure before, this was a new academic adventure. Thus, they reviewed the results stemming from the critical reflection, considered content and process, and wrote up their thoughts on the performance assessment implementation during the 2006 research semester, identifying what they would change for the next use of the performance assessments and rubrics.

Each did so. The review formats and descriptions below range from informal to more formal. The style or format used to document their thoughts was not so important. Instead, in addition to adding tools to their teaching and learning practice, the process of Reflective Practice, critical analysis, and ongoing analysis and change was the ultimate purpose of the process. We have quoted them below.

Abul Azad
Diagnostic Write-up

Performance Assessment 1 (PA1)

The first PA for this course is based upon the initial topics that have been covered within the first few weeks of the class; this is known as the PA1. Within this PA, students needed to design a simple electronic system while considering a number of design factors. During the implementation, students needed to consider a number of pre-conditions. This was something new for the students of this course because students were not familiar with the rubric system, and it was difficult to introduce this.

Midterm

The midterm contains both subjective and objective (multiple choices) items. Considering the relatively smaller mark allocation for the objective type items, it was possible to cover more subject areas.

Test analysis reveals the impact of the items in terms of answering by the students. The item difficulty varied within 73% to 100%, with most of them above 90%. Considering this, the items could be little more challenging. Also the item discrimination is relatively lower for the objective items, with one having a negative value and one divided by zero.

After a review of the midterm items, it appears that all the items are addressing important course topics and these should be a part of the question bank (that has already been developed). Also it may be a good idea to make the items a little more challenging to reduce the item difficulty factor, which will help to differentiate between students' abilities in terms of their performance. To improve the item discrimination, the items can be reviewed for their presentation and also to expose students to items of similar nature through quizzes and course review process.

Midterm Performance Assessment

The PA that linked to the midterm was PA2. The students taking the course have just started their coursework with the Electrical Engineering Technology program, and most of them do not have any experience with the performance assessment and assessment rubrics. So it was a challenge for the students to relate to the provided rubric while completing the performance assessment project.

Students could have scored more points if they could have connected the rubric with the performance of the PA. At the same time, it has also been noted that the rubric can be rewritten to make it little more condensed.

Final

A majority of the items on the course final examination are subjective in nature, while only a few are objective (multiple choices). Test analysis reveals a much better picture than the midterm. For the final, the item difficulty varied within 54% to 81%, which can be considered as an acceptable range. Also the values of item discrimination look pretty good. The lowest one is 0.44, with most of them lying around or above 0.80.

The only thing that can be changed with the test is to include additional objective items of different types.

Final PA

The third PA was the last PA for this course. Considering the timing, this PA addresses all the major topics that have been covered within the course and allows the students to exercise considerable freedom (that means more responsibility) for the project implementation. Relative to the PA1 and PA2, the students have performed well for the PA3. Also in this case, students tried to follow the rubric more when working on the PA3.

Summary statement

The item analysis allows reviewing the impact of examination items on students' performance, and hence faculty can address the identified issues through changing the items' presentation and course's delivery aspect related to a specific item. At the same time, one can add new item(s) or remove an existing item. Considering this as the first year of implementation of this new course planning and delivery strategy, there are a number of things that can be done to make this more effective and to enhance students' learning outcomes. The enhancement can be done through reviewing the existing item bank, developing new items, and trying various teaching and learning models.

PA is a powerful tool in assessing the ability of a student in terms of what one can do or perform after completing a course. Within the delivered course, three PAs were implemented at various times during the semester. It would be useful to develop a PA project bank for the course, along with reviewing/rewriting the existing projects to improve their quality. At the same time, it is important to review the rubrics that have been developed so far.

Bob Tatara

TECH 344 – DIAGNOSTIC WRITE-UPS

Midterm Examination

To improve on midterm scoring and in addition to lectures and homework assignments, the class was divided into two groups to assess the difference between cooperative versus individual learning in four content areas. The content areas were commodity thermoplastics, engineered thermoplastics, thermosets, and elastomers. Random assignment of students to two groups allowed us to assume the groups were equivalent. Each group had approximately 15 students, while each small learning group was composed of three students. The actual delivery of the treatment conditions alternated across content areas and groups. An outline of the experimental model is provided:

Table B.9.d.1:

Tech 344 - Model 4: Individual Learning vs. Cooperative Learning

	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Midterm 10/18/06	----------→	Final 12/11/06
Cooperative Learning Group	Cooperative Learning	Midterm 10/18/06	----------→	Final 12/11/06

Treatment				
Group	Content Area I – Commodity Thermoplastic Study Summary Questions	Content Area II - Engineered Thermoplastic Study Summary Questions	Content Area III - Thermoset Study Summary Questions	Content Area IV - Elastomer Study Summary Questions
1	Individual - 15	Cooperative Groups #1-#5	Individual -15	Cooperative Groups #1-#5
2	Cooperative Groups #1-#5	Individual - 15	Cooperative Groups #1-#5	Individual - 15

It is vital that any groups are legitimate cooperative learning groups in which students are randomly assigned and outperform reasonable expectations by their combined efforts. Additionally, each individual in the group must be independently evaluated. Examples to accomplish this include keeping the group size small, giving written or oral examinations to students, and observing students as they interact within their group. Thus, each group was limited to three individuals. Each group was required to complete an assignment demonstrating knowledge of the content areas, and groups were observed to evaluate learning interactions. Group performance and individual

performance within the group were assessed. A midterm examination was given after four group learning sessions corresponding to the four content areas.

From an item analysis viewpoint, I did not eliminate any items on the midterm; it only had two questions (out of 30) considered for elimination. Both of these had low Item Difficulty (11% and 21%) and Low Item Discrimination (-0.34 and 0.20). A closer examination of the two questions revealed that they were based on reading assignments and items not covered by lectures, student group assignments, or performance tasks. But the items were judged to be reasonable; thus rather than eliminating them, I emphasized that the final would also include questions on the reading of chapters. (This includes material not covered in lectures.) It was also noted that students did not perform better on the items from the four content areas related to the cooperative versus individual, traditional cognitive learning activities. Thus, this led to another change to include more retention questions in the final than originally planned. A total of eight retention questions were included in the final, two from each of the four content areas.

In future courses, it would be beneficial to emphasize that students are responsible for chapter readings as well as lecture materials. Also other group learning models should be tried.

There are systematic techniques available to maximize the individual's performance in a group setting. These techniques cover various ways of forming groups, including ensuring that the groups are random and/or balanced. Different ways of group functioning and dynamic interaction are also documented. A sampling includes rounds where students take turns speaking; group investigation where each group is free to choose a subtopic within the content area of study; discussions where students take opposing sides of an issue; and brainstorming to encourage free-thinking and rapid development of ideas. Overall, individuals should benefit from the group learning process, but this did not occur presently.

Final Examination

Due to rewriting of items based on experiences from the midterm, the overall class performance on the final examination was 10% better than the midterm. There were three questions (out of 50) with low Item Difficulty (one at 14% and two at 21%). However, two of these had reasonable Item Discriminations (0.44 and 0.47), while the third was at -0.34. This third item was discussed in lecture and included in the textbook readings, so there is no good explanation of why the item proved to be so difficult. Only this item was considered for elimination. Three items had Item Difficulty scores of 100%; these items show no discrimination and could also be considered for dropping. But, in the end, all items were retained as a database to be expanded as future exams give more guidance of when to eliminate items. Certainly, it is expected that the experiences from these two examinations will provide for better future test items.

There was even better improvement on the eight retention questions; the students scored 12% better on the retention questions than on the final as a whole. This indicates that if special, or extra, attention is given to critical topics, students are able to perform. Different teaching and/or learning models ought to be considered for such topics. This, in conjunction with better group learning processes, should increase test performance, including performance on retention items.

Performance Assessments

Three performance assessment tasks were assigned. Generally, scores were better on these than the standard tests, as the tasks gave students an alternative opportunity to give evidence of their knowledge. The tasks also tested the students at higher levels of Bloom's taxonomy. One of the reasons for the success of these was the presence of rubrics that were a great asset in the execution of the performance assessment tasks. Students clearly knew the expectations and tailored their work to fulfill the requirements. This led to higher scoring, and the better scores were justified.

The third task included group activities. It appears that students working in groups toward performance tasks benefit more than groups preparing for the midterm and final examinations. Students seem to do better in group settings where more creative, open-ended projects are the goal. Future courses should explore and exploit this trend. Or a cooperative versus individual learning study for performance tasks could be conducted.

Abijit Gupta

Diagnostics of Mid Term Exam
1) Midterm exam was too long. Most students did not have time to attempt all problems.

2) Items (8, 13, 15, 24, 33, 36, and 37), with low discrimination (items with disc below 0.1), and especially items (questions 8, 14, 37), with negative discrimination, certainly cause concern. Items 8 and 13 probably had low disc factor because they were easy (item 8 diff. of 75%, item 13 diff of 91%), but they are good questions and I may keep them for future tests. Item 15 was one of the few theoretical questions, and students knew how use the formula without understanding the derivation. Such questions were not asked in homework or solved in class, and students might not have expected such question. It was also a difficult item with diff of 18%. Item 24 should have been a good item (item diff is 50%), but somehow it had low disc. factor. Maybe students were already getting worried by the time they answered this question that they would not have enough time to finish the exam. I am not too surprised by low discrimination for items 33, 36, and 37 because the students either did not answer them or just guessed randomly due to shortage of time.

3) Regarding difficulty of items, any items being too easy (items 1, 10, 11, 12, and 13) or too difficult (item 4, 15, 21, and 22) were reviewed. Items 1, 11, 12, and 13 were easy, and item 10 probably was trivial. However, I feel that except item 10, they were important questions and there is no need to remove them in future.

4) Since the exam was too long, average was low (41%), and it may not have tested the items that were important but were placed at the tail end of the exam, I made following adjustments:

a) I gave an additional exam that had only some subjective questions and tested concepts that were in the latter part of the exam. Points obtained in this test were added to the regular midterm.
b) I modified the final exam so that it can be finished in time.

Diagnostics of Final Exam
1) Item 13 was too easy, resulting in item diff of 100% and no discrimination. I still do not mind because it is an important concept. The rest of the items seem to have appropriate difficulty index.

2) Items 7, 11, and 15 have negative discrimination factor. Item 7 is an important item and may need to be reworded (avoid double negative). Item 11 probably was due to the fact that during lab instruction the students did not follow why they had to use the trigger. It should be made clear in next lab session. Item 15 is a concept they should know from the midterm and may not have remembered correctly.

3) Overall I am pleased with the outcome of the exam.

Diagnostic of Performance Assessment 1
My observation for performance assessment#1 is as follows: PA#1 was interesting and students learned a lot. The project required vibration/acoustic measurement by every student in an industrial setting. It was difficult to find enough companies who would permit such measurement and even fewer companies have their own measuring equipment. We have a limited number of instruments, so if possible, more instruments should be purchased. Since the students did not have any background in vibration measurement when they participated in this exercise, they needed lot of help that was beyond the scope of the teaching assistant. Fortunately, I had a research assistant with lot of experience in vibration/acoustic measurement and he helped me out. However, such help may not always be available and the project accomplishment may be compromised.

The mathematical model was difficult because this was assigned at the beginning of the semester, so it was not a good item in the rubric.

Due to lack of time, no in-class presentation was possible (because that would take away one class) and only the report was graded. It was not clear initially to the students how they show their contribution to the team and, therefore, required explanation in class. In future this will be more structured.

Another issue was that different groups addressed different problems and had different levels of support from the companies they visited and also some problems were easier (or more difficult) than the others. This issue was addressed in PA #2 and PA #3, where every group performed same projects.

Diagnostic of Performance Assessment#2
My observation for performance assessment #2 is as follows: PA#2 went more smoothly than the PA#1 because students were dealing with a familiar product. However, there were some small issues such as students did not understand just mentioning internet or local shop visit is not enough and they needed to be more specific: URL for the internet sites, name and location of the local stores, etc. Students gave oral presentation for this assignment, and I pointed out how to present these better. One group actually did more than that was asked, and I gave extra credit for that.

One problem I think was that since half of the class (experimental group) had to finish it before the midterm, the midterm was given somewhat late in the semester without giving students a chance to drop the course.

Diagnostic of Performance Assessment #3
My observation for performance assessment #3 is as follows: For PA#3, the students worked hardest. That was possibly due to many reasons: baseball is a popular sport, Sammy Sosa made corking infamous, any baseball player would be interested to know the location of sweet spots and how to choose a better bat, etc. The students also learned some concepts (orthogonality, mass normalization, mode shapes etc,) better due to this assignment. Only one item in the rubric (stiffness matrix for the baseball bat) was too difficult, and in future if such question is asked, more clues may be provided. During

grading, I realized that this rubric did not ask specifically to show individual work. Almost every group provided some information that was relevant, but it led to same score for every member of the group. I will decide in future whether that is OK or if I should require more detailed information to ensure that everyone participated equally.

Overall Impression (all Performance Assessments considered together)
Overall, my impression was that the students performed better than I expected. They worked very hard. Some said to me that they could do it because only one course required these and they would not be able to do these if more than one course required them.

First assessment was probably given too early and the last one too late. In the future, at most two Performance Assessments should be given. However, Performance Assessments definitely augmented the learning of students.

Brianno Coller

Comments on midterm concept test
Two of my questions were flagged for a low discrimination index.
Problem 24. It appears that quite a few people believed that this was a two-force member. It is not. The problem clearly states that the bracket has weight. The center of gravity clearly appears on the diagram. I think it is a good question. Nonetheless, I reduced the number of possible points by one for this question – just because the students needed it and I was feeling charitable.

Problem 33. I am not sure why this problem had such a low index. This problem was not stated any differently than problems 30, 31, 32, and 34, all of which had moderately high discrimination indices. Of these five equilibrium problems, however, it is the one that had the lowest item average. Again because I was feeling charitable, I reduce the total by an additional point.

Comments on final concept test
Problem 6. On its surface, this looks like a quite simple problem. But because of the horizontal forces, it is actually a bit harder. It takes some doing to work it out correctly. Since I told students they could not use their calculators, this is a bit unfair. Therefore, for this problem, I reduced the total possible points by one. Doing so turns out to be quite a bonus for the students, since the answer is the same one that you might guess if you did not go through all that extra calculation.

Problem 17. I do not know why the discrimination index was negative here. Problem 16 refers to the same system and its discrimination index is quite reasonable. Therefore, I suspect the question is written reasonably well. In my opinion, problem 17 is more difficult and requires more thought than problem 16. Nonetheless, problem 17 had a significantly higher item average. So here is my guess as to what happened. Some students reason through problems the way we tell them to: draw a free body diagram and set up equilibrium conditions. Other students rely on their intuition. Usually, relying on intuition without going through the analysis steps is a bad idea. However in this problem, it might have been the strategy most likely to succeed.

Problem 20. I think the discrimination index was low because the item average was especially high.

Problem 28. One of the students pointed out that this question had problems with it. I need to give the angles of the string if it is to be determinate. I reduced the number of possible points by 1 because of this problem.

Problems 32, 33. When discussing this with my TA, these turned out to be harder than I expected. The test statistics bear this out. I removed these two points.

Reflections on Performance Assignment #1

Performance Assignment #1 was given very early in the semester. Its purpose was get students involved with statics analysis early, using techniques amenable to students just beginning the class, and to motivate students for the type of questions we would analyze and answer throughout the semester.

One half of the class used a hands-on experimental approach to determine string tensions in a pulley system. The other half of the class used a graphical force triangle approach. Anecdotal feedback from the students suggests that students enjoyed applying their analysis to a (seemingly) realistic situation. The biggest difficulty with the performance assignment appeared in the experimental group. The students in this group had a difficult time interpreting their experimental measurements. Specifically, many of the students did not recognize the error in their measurements. They interpreted some of the fluctuations in their measurements as something of physical significance, when in reality, it was due to error.

I can think of three things I can do to mitigate this in the future:

1. Discuss measurement error in the assignment.
2. Buy cheap spring scales with which students can more simply read the forces. This might be less prone to error than measuring spring lengths and then computing forces based on these lengths.
3. Make students compare their results with a classmate. It is unlikely that two students will have the same fluctuations.

Reflections on Performance Assignment #2

I really liked how this assignment turned out. Students formed teams and had to design a cart to compete in a tug of war competition. They had to recognize that there are two ways their cart could lose: either by sliding or by tipping over. There were firm constraints on their design, and they would have to base their design on anticipating what their opponent might choose to do. Furthermore, there was a bit of random uncertainty that teams had to cope with.

The best approach to designing the cart is not something that comes naturally to novice engineering thinkers. Most students recognized both failure modes and further noticed that the two modes work against each other. For example, if one makes the cart more resistant to sliding, it often makes it more susceptible to tipping and vice versa. The best option, therefore, is to design the cart so that both failure modes occur simultaneously.

Four teams (16 students total) were able to figure this out on their own. Three teams were able to implement it correctly. One of these three teams beat my design.

After the competition, I made a presentation in lecture, describing this design philosophy of coincident failure modes. Although a relatively small fraction of the students were able to figure it out on their own before the competition, almost all were able to understand it and appreciate it afterward. Almost all teams employed this strategy in Performance Assignment #3.

There is one thing I would do differently. In Fall 2006, I ran the competition (a simulation) at home over the weekend . It would be more exciting and more suspenseful to run it in class.

Reflections on Performance Assignment #3
In this exercise students had to design and build trusses. The goal was to support as much weight as possible while adhering to the constraints imposed upon them. The exercise came in three parts. First, students individually had to analyze a truss by hand. In part 2, they teamed up with one other student to write a Matlab script to perform the analysis. Finally, in Part 3, they joined the rest of their team to perform the design.

In parts 1 and 2, I gave the students trusses with two different topologies to analyze. Both trusses satisfied the design constraints. Therefore, in part three of the exercise the teams had to figure out which topology was better and perhaps explore a topology that is even better than the original two. It turned out (not by accident) that a third topology was better than the two given. Several teams figured this out. Nonetheless, the teams that stuck with the old truss topologies were able to create very good designs. On the last day of lecture, we broke the trusses. It was fun.

The next time I teach the course, I plan to post targets for student design teams to shoot for. I can tell them how much (scaled) weight a really good truss should hold, so they get feedback that tells them how good their design is.

Reinaldo Moraga

Analysis of Midterm
The total number of multiple-choice items in the midterm exam was 25, from which five resulted in a difficulty index below 50%.

Items 4, 6, 11, 15, and 22 resulted in a discrimination index 0.37. After analyzing the items, the conclusion is that they were poorly written and some of the distracters were very similar to the right answer; thus students might have been a little confused. In all these cases, a paraphrase of the items would be desirable.

Analysis of Final
The total number of multiple-choice items in the final exam was 25, from which eight resulted in a difficulty index below 50%.

Item 1 has a low discrimination index (0.075), which means extreme students got the item right. There is no major problem with the item itself, except that the content is a difficult one.

Items 3, 12, 18 and 21 have decent discrimination indexes (0.33 - 0.44), which means that these items were answered correctly by higher grade students. The correct choices from these items are very similar to distracters, which may have confused some of the students.

Item 6 was difficult and with negative discrimination index. This is because the item was poorly written, so this item was not a good one.

Items 11 and 24 have low discrimination index because they required some analysis and interpretation of given facts.

Four other items (5, 8, 10, and 16) were found to be easy items but with negative discrimination index. In some cases, higher grade students answered incorrectly because the items were poorly written.

Change of Performance Assessments
The Performance Assessments (PAs) for this class were the following ones:

> *PA 1: Research on OR Applications*.
> Strength: This PA was open in the sense that students were given a journal to select one article to discuss. Higher Bloom's Taxonomy.
> Weakness: There were cases in which students selected extremely difficult articles and were overwhelmed by them.
> Change: I think next time I should select an article and give it to each group to analyze.
>
> *2: Analysis and Solution of a LP Case Study*.
> Strength: This PA was properly assigned for the students and students were able to work well on it. Higher Bloom's Taxonomy.

Weakness: Do not see it clearly.
Change: No one for this type of activity.

PA 3: Applying LP to Real-World Problem.
Strength: This PA was open in the sense that students were supposed to find a real application of the topics. Higher Bloom's Taxonomy.
Weakness: Some teams came up with similar cases, and even though they worked well on them, the class did not benefit from having a variety of cases.
Change: Next time, I would assign a particular topic for students to get a real-world problem or I would monitor more carefully the cases studies they are selecting from the very beginning.

Changes for the Courses

Next time I teach ISYE370, I would implement cooperative learning throughout all the contents of the course, and I would design contents with more activities, taking advantage of the students' learning styles. I think this is something I would like to use in some other courses as well.

Regina Rahn

Statement of Changes/Concerns Based in Item Analysis: IENG 475

After reviewing the item analysis for the midterm and comparing both the item discrimination and the item difficulty to the results from Fall 2005, it became apparent that the results were not satisfactory for Fall 2006. The main problems were with the discrimination numbers. They were all over the board. In the fall of 2005, when a test was administered that did not implement multiple choice, true/false, etc., the numbers were much better. I discussed this at some length with the students. We all came to the same conclusion: this format was not conducive to success for a senior/graduate level course in engineering, where many of the examples and homework focus on multi-step implementation of problem solving techniques.

The format was changed for the final. This time the questions were still what I consider to be objective, where a correct answer exists and is attainable. However, the short answer format was used so more partial credit was available. This resulted in somewhat improved numbers in the item analysis.

This is the first time that I ever used item analysis. I believe that it provides the instructor with invaluable information, allowing him/her to be able to make improvements continually during the semester. I will definitely continue to use this in the future.

STUDENT ASSESSMENT SUMMARY
Jule Dee Scarborough, Ph.D.
(See Portfolio Sections B.9.a,b,c,d, and B.9.e.1-5; also, A.5 and A.7)

Excerpt from Student Assessment Summary, B.9

Once the 2005 test analyses were completed and we determined that there were no performance assessments in any of the courses, the professors designed and developed new midterm and final exams for the 2006 course. Using the results of those analyses diagnostically and the new 2006 student learning outcomes, the professors developed a Table of Specifications to guide their creation of a new midterm and final exam for the 2006 course. They each developed an objective test item bank of multiple questions for each student learning outcome. Once the objective test items were developed, they chose items for each exam, midterm and final, and assembled the tests. If they preferred to include problems to solve, those were added as well. The program leaders provided feedback throughout the entire analysis and development process. To further ensure that the test items and assembled tests actually measured knowledge or skills inherent in an outcome, the professors mapped the outcomes to the corresponding tests and specific items. This helped them realize where they needed more items or a different type of item and, especially, where there were gaps in the measurement of critical outcomes. (See worksheet below and other examples in B.9.2.e.1-5.) Although the tests were not perfect, they were greatly improved. (See Portfolio Section B.9.a for the comparison for differences between the 2005 and 2006 tests; see Program Description, Portfolio Section A.7, for further information on the Test Analysis and Development program components.)

Faculty examples of their course outcomes to test and test item analysis are copied below.

B.9.e.1: IENG370 Operations Research – R. Moraga (Explanation in B.9)

	Student Learning Objectives and Outcomes			Assessments: Test Alignments Midterm & Final
	Student Learning Objectives/Outcomes-Major	**student learning objectives - minor**		**Corresponding Tests and Test Items**
1	1. To apply fundamental methods of deterministic operations research models to solve industrial engineering problems (related to planning, scheduling, budgeting, etc.) 1.1. To apply linear programming (LP) models	**a**	To formulate LP models	Exam1, MC1-4/SA17-20; Final, MC1-3/MTF17-20
		b	To solve a LP model by applying the Simplex Algorithm (SA)	Exam1, MC5-8; Final, MC4,5
		c	To analyze and interpret results by applying sensitivity analysis	Exam1, MC9-16 Exam2
		d	To examine special cases of LP models (transportation and networks) and to solve them using modified SA versions	Exam2
2	1. To apply fundamental methods of deterministic operations research models to solve industrial engineering problems (related to planning, scheduling, budgeting, etc.) 1.2. To apply integer programming (IP) models to solve industrial problems.	**a**	To formulate IP models	Exam2
		b	To solve IP models by using the branch and bound algorithm (BBA)	Final, MC8-11/SA13-16
3	1. To apply fundamental methods of deterministic operations research models to solve industrial engineering problems (related to planning, scheduling, budgeting, etc.) 1.3. To acquire basic knowledge of dynamic programming (DP) modeling to solve LP models.	**a**	To reformulate a LP model using DP modeling.	Final, MC6,12
		b	To apply the dynamic programming recursive approach.	
4	2. Students will apply the appropriate LP model to solve a real-world problem. 2.1. To choose a real-world problem from the following sector: manufacturing, services, banking, transportations, educational, or health care.			Project
5	2. Students will apply the appropriate LP model to solve a real-world problem. 2.2. To define the problem	**a**	To describe context situation.	Project
		b	To identify at least 10 decision variables for the problem	
		c	To identify at least 10 constraints for the problem	
6	2. Students will apply the appropriate LP model to solve a real-world problem. 2.3. To formulate the problem using a LP model	**a**	To apply assumptions of LP models	Project
		b	To define decision variables and technological coefficients	
		c	To define and construct a performance criterion	

		d	To construct the region of feasible solutions	
7	2. Students will apply the appropriate LP model to solve a real-world problem. 2.4. To solve the problem using SA	**a**	To reduce any LP model to the standard form	Project
		b	To apply steps of the SA and its fundamental algebra	
8	2. Students will apply the appropriate LP model to solve a real-world problem. 2.5. To analyze and interpret results			Project
9	2. Students will apply the appropriate LP model to solve a real-world problem. 2.6. To communicate results in a manner that unites theory, reasoning, analysis, and criticism in speaking and writing.	**a**	To write a technical report	Project
		b	To present the report	

This class has three exams. MC: Multiple Choice; SA: Short Answers; MTF: Multiple True-False

B.9.e.2: Course Title and Number (Explanation in B.9) Abul Azad, Technology 277

	Student Learning Objectives and Outcomes			**Assessments: Test Alignments Midterm & Final**
	Student Learning Objectives/Outcomes- Major	**student learning objectives - minor**		**Corresponding Tests and Test Items**
1.	To examine the components of a digital system.	**a**	To contrast between analog and digital signals	Multiple choice: 1aA1, 1bC1, 1cC1, 1cC2, 1dK1, 1dK2, 1eC1
		b	To classify binary digits, logic levels, and digital waveforms	
		c	To compare basic logic operations	
		d	To categorize fixed function integrated circuits	
		e	To interpret the operation of simple digital systems	
2.	To examine the structures for various number systems.	**a**	To distinguish between various parts of number systems.	Multiple choice: 2aC1, 2aA1, 2bC1, 2bC2 Short answer: 2aK1, 2aK2, 2aK3, 2aC1
		b	To examine the counting in binary, octal, decimal, and octal.	
3.	To distinguish the conversion methods for various number systems.	**a**	To convert between binary and decimal	Multiple choice: 3aA1, 3aA2, 3aA3, 3aA4, 3aA5, 3bA1, 3bA2, 3bA3, 3cA1, 3cA2 Short answer: 3cC1, 3bA2, 3bA3, 3cA1, 3cA2
		b	To convert between binary and hexadecimal	
		c	To convert between binary and octal	
4.	To perform different binary arithmetic operations: addition, subtraction, 1's complement, 2's complement, and signed numbers.	**a**	To examine the basic rules involving each of the operations.	Multiple choice: 4aC1, 4aC2, 4aC3, 4bA1, 4bA2, 4bA3, 4bA4. Short answer: 4bA1, 4bA2, 4bA3, 4bA4, 4aK1
		b	To use the rules to perform each of the operations.	
5.	To examine the operation and use of various logic gates with different input patterns: AND, OR, and NOT, NAND, NOR, XOR and XNOR.	**a**	To develop the truth tables of various logic gates using established rules.	Multiple choice: 5bC1, 5bC2, 5cA1, 5dA1, 5dA2, 5cA2, 5dA4, 5dA5. Short answer: 5bC1, 5bC2, 5bC3, 5bC4, 5bC5, 5bC6, 5dC1, 5dC2
		b	To use the truth tables to identify output pattern of a logic gate for a given set of input.	
		c	To predict output logic levels for a pulse input pattern.	
		d	To recommend the use of appropriate logic gate(s) for a given application.	
6.	To analyze the properties of fixed-function logic integrated circuits (IC): Complementary Metal Oxide Semiconductor (CMOS) and Transistor-Transistor Logic (TTL).	**a**	To identify various supply voltage and power requirements for CMOS and TTL ICs.	Multiple choice: 6aA1, 6aA2, 6bA2, 6bA3, 6cA1, 6dC1, 6fC1, 6fC2 Short: 6aK1, 6aK2, 6aK3, 6aK4, 6bK1, 6bK2, 6bK3, 6bK4, 6cK1, 6cK2, 6eC1, 6eC2, 6fK1, 6fK2, 6fK3, 6fK4, 6fK5, 6fK6, 6fK7, 6fK8.
		b	To analyze the generic numbering convention for CMOS and TTL ICs.	
		c	To classify common logic gate ICs according to their standard identifier digit.	
		d	To examine the logic gate configuration within an IC.	
		e	To compare alternative logic symbols for representing logic gates while drawing a circuit diagram.	
		f	To examine the voltage values for input output logic levels for CMOS and TTL ICs.	

7.	To analyze the performance characteristics and parameters for logic gates and evaluate their significance in digital design.	**a**	To estimate the propagation delay for a given logic gate and realize its significance in digital design.	Multiple choice: 7aA1, 7aC1, 7bA1, 7cA1, 7dC1 Short answer: 7aC1, 7aA1, 7bA2, 7cA1, 7dC1
		b	To estimate the speed-power product as a measure of the performance of a logic circuit.	
		c	To estimate fan-out and loading conditions while designing a logic circuit.	
		d	To interpret data sheets for different logic gate ICs.	
		e	To evaluate data sheet information while making design decisions.	
8.	To use Laws and Rules of Boolean algebra and DeMorgan's Theorems for manipulating Boolean expressions.	**a**	To use the commutative, associative, and distributive laws to manipulate Boolean expressions.	Multiple choice:8aK1, 8aC1, 8bC1, 8cA1, 8cA2 Short answer: 8aK1, 8aK2, 8aK3, 8aK4, 8aK5
		b	To examine the use of Boolean rules while manipulating Boolean expressions.	
		c	To use DeMorgan's Theorems for manipulating Boolean expressions.	
		d	To adapt the Boolean laws, Boolean rules, and DeMorgan's Theorems while minimizing Boolean expressions.	
9.	To analyze digital logic circuits using Boolean algebra.	**a**	To develop a Boolean expression for a given logic circuit.	Multiple choice: 9aA1, 9aA2, 9cA1, 9cA2 Short answer: 9aC1, 9aC2
		b	To evaluate a Boolean expression and prepare a truth-table for the logic circuit.	
		c	To demonstrate the use of Boolean algebra while minimizing Boolean expressions.	
10.	To develop and analyze standard forms of Boolean expressions: Sum-of-Products (SOP) and Product-of-Sums (POS).	**a**	To manipulate Boolean expressions to form SOP and POS.	Multiple choice: 10aC1, 10aC2, 10aC3, 10bA1, 10bA2
		b	To implement SOP and POS expressions using available logic gates.	
		c	To convert Boolean expression between Standard SOP and POS forms.	
11.	To evaluate the relationship between truth tables and standard forms of Boolean expressions (SOP and POS).	**a**	To transform SOP expression to truth table format.	Multiple choice: 11cA1, 11cA2, 11dA1, 11eA1 Short answer: 11cC1, 11dc!, 11eC1
		b	To transform POS expressions to truth table format.	
		c	To develop standard form of expressions from a truth table.	
		d	To convert non-standard forms SOP forms to standard SOP form	
		e	To convert non-standard forms POS forms to standard POS form	
12.	To minimize logic expressions using Karnaugh map (K-map).	**a**	To develop K-maps with different size of input variables (1 to 4).	Multiple choice: 12cA1, 12cA2 Short: 12bC1, 12bC2, 12cA1, 12cA2, 12dA1
		b	To map SOP expressions on K-maps.	
		c	To develop minimized expressions from K-maps.	
			To construct K-map from a non-	

		d	structured SOP expression.	
13.	To analyze digital systems using combinational logic.	**a**	To design a combinational logic system for a given problem.	Multiple choice: 13fA1, 13fA2 Short answer: 13fA1
		b	To design a logic circuit using standard logic gates from a given Boolean expression.	
		c	To design a logic circuit from a truth table.	
		d	To design logic circuit only with NAND or NOR gates.	
		e	To analyze the operation of a combinational logic circuit with pulse inputs.	
		f	To develop Boolean expression from a given logic circuit	
14.	To evaluate combinational logic circuits for commonly used digital functionalities: Half-adders and full-adders, parallel binary adders, comparators, BCD to decimal decodes, BCD to 7-segment decoders, encoders, multiplexers, and demultiplexers.	**a**	To examine their design principles	Multiple choice: 14aC1, 14aC2, 14aA1, 14aA2, 14aC3, 14aC4, 14cC1, 14dK1, 14dA1, 14dK2, 14fK1, 14dK3, 14fK2, 14fK3, 14fK4, 14fK2, 14iK1, 14gK3, 14gK4, 14gK5, 14jK1, 14jK2 Short answer: 14aK1, 14aK2, 14bK2, 14dC2, 14fK1, 14gK1, 14iA1, 14jK1, 14jK1
		b	To develop combinational logic circuits using commercially available ICs to implement these common digital functionalities.	
		c	To analyze the design of a magnitude comparator.	
		d	To analyze the function of a decoder.	
		e	To design and develop higher size decoder using smaller size decoder ICs.	
		f	To explain the use of BCD-7-Segment decoder for a real-life application.	
		g	To explain the design of encoders using commercial ICs.	
		h	To analyze the function of an encoder.	
		i	To evaluate the operation of multiplexers and their implementation using commercially available ICs.	
		j	To evaluate the operation of demultiplexers and their implementation using commercially available ICs.	

15.	To evaluate the properties of Latches, Flip-Flops, and timers.	**a**	To contrast between Latches and Flip-Flops.	Multiple choice: 15aK1, 15bK1, 15cK1, 15dK1, 15eC1, 15gK1 Short answer: 15aK1, 15bC1, 15bC2, 15bC3, 15bC4, 15cC1, 15cC2, 15dC1, 15dC2, 15eA1
		b	To evaluate the properties of edge-triggered J-K Flip-Flop.	
		c	To evaluate the properties of edge-triggered D Flip-Flop.	
		d	To evaluate the properties of edge-triggered S-R Flip-Flop.	
		e	To utilize the asynchronous Preset and Clear inputs of Flip-Flops.	
		f	To examine the operating characteristics of Flip-flops, such as-propagation delay times, set-up time, hold time, Maximum clock frequency, Pulse width, and Power dissipation.	
		g	To compare the properties of commercially available Flip-Flop ICs.	

16.	To examine the use of Flip-Flops in practical applications.	**a**	To design parallel data storage using Flip-Flops.	Multiple choice: 16aK1, 16bK1, 16aA1, 16aA2, 16cC1, 16cC2, 16cA1, 16cA2 Short answer: 16bA1, 16cA1
		b	To implement frequency division using Flip-Flops.	
		c	To design binary counter using Flip-Flops.	
17.	To design applications using the 555 Timer	**a**	To use 555 timer for monostable operation.	Multiple choice: 17cC1, 17bC1, 17cC1, 17cA1, 17bA1, 17aA1
		b	To use 555 timer for bistable operation.	
		c	To use 555 timer for astable operation.	
18.	To design and study of counter applications using Flip-Flops.	**a**	To design and analyze asynchronous binary counters.	Multiple choice: 18aC1, 18cC1, 18aA1, 18aA2
		b	To design and analyze asynchronous decade counter.	
		c	To design and analyze synchronous binary counter.	
		d	To design and analyze synchronous BCD decade counter	
		e	To design and analyze up/down synchronous counter	
19.	To design and study of various shift register applications.	**a**	To demonstrate the use of D Flip-Flop as a shift register.	Multiple choice: 19aC1, 19bC1, 19cA1
		b	To design and develop serial In/ serial Out shift register.	
		c	To design and develop serial In/ parallel Out shift register.	
		d	To design and develop parallel In/ serial Out shift register.	
		e	To design and develop parallel In/ parallel Out shift register.	
		f	To design and develop bi-directional shift register.	

B.9.e.3: IENG 475 - Decision Analysis – Regina Rahn **(Explanation in B.9)**

<table>
<tr><td colspan="4">Student Learning Objectives and Outcomes</td><td>Assessments: Test Alignments Midterm & Final</td></tr>
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1. To define the states of nature of the system, process, or situation
2. To develop the branch structure of the tree
a. To identify decision nodes; what are the items the decision maker chooses
b. To identify the chance nodes; the events that occur by chance with a given probability
c. To draw the arcs, which define the sequences and relationships between nodes
3. To identify the outcomes
a. To define the choices for a decision node
b. To define the possible outcomes of a chance node, which are a set of mutually exclusive outcomes
c. To define the “consequence,” or the final outcome of a branch
4. To solve for the expected value of the decision tree (EV, EMV)
a. To construct the joint, conditional, and marginal probabilities
b. To calculate all branch probabilities of the tree
i. To apply Baye’s Theorem
ii. To implement the inverse tree structure technique
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HW #2 (A)

HW #3 (B,C)

HW #4 (D)

HW #5 (E)

Performance Task #1 (A)

Midterm # 1-18 (A)

Midterm # 19-21(B)

Midterm # 22-30 (C)

Final # 19-22 (A)

Final # 6-10, 23-25 (C)

Final # 1-5 (D)

Final # 11-18 (E)</td></tr>
</table>

		B	Students will be able to construct the formulae for conditional likelihood ratios and to calculate the probabilities/ratios 1. To calculate the conditional likelihood ratio (CLR) associated with a particular observation 2. To calculate the CLR for multiple observations 3. To compare these results with Baye's Theorem	
		C	Students will be able to construct a single-attribute utility function 1. To propose a lottery that would be appropriate for evaluation of risk 2. To calculate the necessary values from the lotteries needed for analysis a. To calculate the certainty equivalent b. To calculate the risk premium c. To calculate the selling price d. To calculate the buying price e. To calculate the insurance premium 3. To translate the lotteries into a mathematical function 4. To create a graphical interpretation of the function 5. To analyze and compare two lotteries at a time, to be used when a reference point is needed	
		D	Students will be able to develop and analyze fault trees 1. To describe the events of a tree for a given scenario a. To identify the top event b. To define primary and secondary failures and command faults c. To identify the sequence of events 2. To create the fault tree for a given scenario (such as the safety analysis of a system) using deductive analysis a. To define the "and" and "or" gates b. To implement the logic symbols into the tree 3. To develop and analyze dual fault trees a. To translate the meaning of a system failure into the reliability of the system	

		E	Students will be able to construct a multi-attribute utility function 1. To construct a graphical model for the function 2. To develop a mathematical model for the function	
II	To apply analytic decision making techniques for technical decision making under uncertainty and to analyze and evaluate the results.	**A**	Students will be able to perform sensitivity analysis on a decision tree scenario 1. To construct a graph to interpret the results a. To plot the two dimensional plane for a single chance node sequence i. To interpret the graph b. To plot the plane for two sequential chance events (plot the pq plane) i. To interpret the graph 2. To determine the threshold probability levels a. To decide if the current solution is a good one and justify the decision b. To determine the salient factors (variables) in the decision being modeled by the current tree c. To make recommendations for improvements	HW #1 (**A**) HW #2 (**A**) HW #3 (**B,C**) HW #4 (**D**) HW #5 (**E**) Performance Task #2 Midterm # 1-18 (**A**) Midterm # 19-21(**B**) Midterm # 22-30 (**C**) Final # 19-22 (**A**) Final # 6-10, 23-25 (**C**) Final # 1-5 (**D**) Final # 11-18 (**E**)
		B	Students will be able to make inferences about a system based on the values of the conditional likelihood ratios 1. To determine the pass or fail rates allowed for a given set of specification limit 2. To determine probabilities of occurrence for multi-variate systems based on the values of the CLR’s	

		C	Students will be able to evaluate a given utility function 1. To analyze the degree of risk aversion from the utility function; risk prone, risk averse, risk neutral 2. To assess the process being modeled; is the model sufficient a. To determine if the model needs to have more attributes 3. To recommend any changes in the model a. To decide if more iterations are necessary for the lotteries b. To decide if any of the lotteries need to be referenced c. To determine if the utility function is consistent with the behavior of the decision maker	
		D	Students will be able to evaluate the scenarios modeled by a fault tree 1. To determine the reliability and failure probability relationships 2. To propagate the probabilities through the gates 3. To perform a qualitative evaluation a. To determine cut sets, as well as the minimal cut set 4. To perform a quantitative evaluation a. To determine cut sets, as well as the minimal cut set b. To develop the equivalent fault tree c. To obtain the numerical probability that a given cut set induces failure of the system 5. To implement the additive model for multi-attribute scenarios	
		E	Students will be able to implement the additive model for multi-attribute utility theory 1. To assess a two-attribute utility function 2. To determine the weights of the functions (the k’s)	

III	To structure and solve complicated decision problems	**A**	Students will be able to define a scenario to be analyzed with the decision analysis techniques 1. To research an area in which the tools can be applied, and to choose a problem for study 2. To define the scope for the problem chosen 3. To determine a set of objectives for the given problem	HW #2 Performance Task #2 Performance task #3
		B	Students will be able to formulate/design a possible solution approach to the given problem 1. To determine an appropriate solution technique to be applied to the problem from the set of available tools 2. To formulate the solution	
		C	Students will be able to implement the solution techniques to obtain a first round solution 1. To solve the formulation	
		D	Students will be able to analyze the solution found in order to assess the current state 1. To assess/analyze the value of the solution found (does it make sense numerically?) 2. To evaluate the significance of the solution (what does this mean for the decision maker?)	
		E	Students will be able to recommend a course of action based on the original solution 1. To establish if the decision maker is risk averse, risk prone, or risk neutral 2. To recommend the path that the decision maker should embark upon, based on the results	

		F	Students will be able to assess the usefulness of the solution and recommend any changes in the process 1. To evaluate if the current solution adequately answers the most important questions facing the decision maker 2. To analyze the solution for computational accuracy 3. To decide if the solution should be improved upon a. To conclude if factors (attributes) need to be added b. To conclude if factors (attributes) need to be removed c. To determine if the correct probabilities were utilized	
IV	To identify and define any limitations of the models and techniques for rational decision-making.			Performance Task #2 Performance Task #3
V	To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario	**A**	Students will explain results via a formal presentation	Performance Task #2
		B	Students will explain results via a formal written technical report	Performance Task #3

B.9.e.4: Worksheet Objectives and Tests- May15_MEE321 **(Explanation in B.9)**

MEE 321 Mechanical Vibrations I

Student Learning Objectives and Outcomes				**Assessments: Test Alignments Midterm & Final**
	Student Learning Objectives/Outcomes-Major	**Student Learning objectives - minor**		**Corresponding Tests and Test Items** Midterm abbreviated as M Final abbreviated as F
1	A. Classify types of Vibration	**a**	Discuss common vibration phenomenon i) Identify if vibration is Deterministic and classify as a)Sinusoidal, b) Periodic, and c) Transient ii) Identify if vibration is Random and classify as a) Stationary and b) Non Stationary	M -1, 2
		b	Identify the source of excitation as i) Free or ii)Forced Vibration	
		c	Identify possible source of energy loss and classify as i) Undamped or ii) Damped	
		d	Classify the system as i) linear or ii) nonlinear	
	B. Solve Kinematics and Kinetics problems involving particle and rigid body analyses.	**a**	Define degrees of Freedom	M-3, M-4,M-20, M-30
		b	Solve Particle Kinematics problems for i) Velocity analysis, and ii) Acceleration analysis	M-5
		c	Solve Rigid Body Kinematics problems for i) Relative Velocity analysis ii) Relative Acceleration analysis	M-6, M-9, M-32
			Decide how to choose	M-6,

		d	Particle and/or Rigid Body formulation	
		e	Solve the kinetics problem i) Identify method of solution by identifying list of variables ii) Draw FBD and MAD to solve for instantaneous forces/accelerations	M-6, M-7, M-8, M-9 M-21, M-22, M-31, M-32
	C. Convert a real life vibration to a mathematical statement	**a**	i) Convert a complex system to simple sub-systems ii) Draw the Schematic of the sub-systems	M-10 M-11
	D. Identify basic elements used to solve vibration problem.	**a**	Compute equivalent stiffness for i) springs in series ii) springs in parallel, or iii) combined effect in a SDOF system	M-12, M-13, M-36
		b	Compute equivalent mass	
	E. Analyze vibration of a system subjected harmonic and periodic motion	**a**	Define basic vibration terminology for sinusoidal motion	M-14
		b	i) Obtain Fourier series expansion for periodic motion ii) Reconstruct a periodic wave from first few harmonics	M-15, M-16
2	A. Solve for free undamped vibration of a Single Degree of Freedom System	**a**	Identify the degree of freedom	M-17, M-20
		b	i) Derive equation of motion for undamped translation system	M-17,M-18
			ii) Solve the differential equation of motion and compute natural frequency	M-19
			i) Derive equation of	

		c	motion for undamped rotational system ii) Solve the differential equation of motion and compute natural frequency	M-17, M-18 M-19, M-23
	B. Apply modeling of free vibration of undamped System	**a**	i) Use compound pendulum for solving moment of inertia ii) Compute center of percussion and use it for sports applications	
	C. Check system stability	**a**	Compute equivalent mass and system and check if system is stable	
3	A. Solve for free vibration of a viscously damped Single Degree of Freedom System	**a**	Derive equation of motion of a viscously damped SDOF system	M-20, M-21, M-22, M-23, M-24, M-33
		b	Compute Critical Damping Constant and Damping ratio	M-24, M-34
		c	Solve for the response of i) underdamped, ii)critically damped and iii) overdamped system due to given initial conditions	
		d	Compare the undamped and damped natural frequencies and understand its relevance in terms of comparison of theory and experiment	M-25, M-26, M-27, M-28, M-29
		e	Use log decrement to measure damping.	
	B. Solve for free vibration for other types of damping	**a**	Identify other types of damping.	
		b	Derive the equation for columb damping	

		c	Compute energy loss for hysteretic damping	
4	Solve for forced vibration of Single Degree of Freedom Systems	**a**	Derive the equation of motion from FBD & MAD	M-30, M-31, M-32
		b	i)Use the FBD and MAD to solve for the steady state solution due to harmonic excitation ii) Compute the total response iii) Estimate damping ratio from half power bandwidth	M-35, M-41
		c	Define transmissibility and observe the effect of damping and frequency ratios on transmissibility.	M-39, M-40
		d	Solve for the response of a system due to motion of base	M-38
		e	Solve for the response of a system subjected to rotating unbalance	F-1, F-2, F-3, F-4
		f	Design systems for desired vibration isolation.	F-5, F-6, F-7, F-8, F-9
5	Solve for free vibration of a 2DOF system	**a**	i) Identify the appropriate 2DOF ii) Construct FBD and MAD in terms of the chosen 2DOF	F-10, F-11, F20, F-21
		b	Use the FBD and MAD to derive equations of motion	F-12, F-13
		c	Identify mass, stiffness, and damping matrices from the equations of motion.	F-14, F-15, F-22, F-23, F-28, F-29
		d	Solve for undamped natural frequencies and mode shapes.	F-16, F-17, F-18, F-19, F-27
		e	Solve for modal properties of a semidefinite systems	F-24,F-25, F-26, F27, F-30, F-31, F-32
6	Solve for forced vibration of 2DOF systems	**a**	Use the equation of motion to solve for steady state response due to harmonic excitation directly by impedance method	
		b	Use Matlab to solve the equations of motion directly-by state space method.	

7	Solve for general eigenvalue problem	**a**	Derive equations for MDOF systems & solve for natural frequencies and mode shapes in closed form.	F-28, F-29, F-30, F-31, F-32
		b	i) Check orthogonalilty of mode shapes with respect to mass and stiffness matrices ii) Use the orthogonality to decouple equations of motion. iii) Compute mass normalized mode shapes.	F-33
		c	Solve for natural frequencies and mode shapes by Matlab	
		d	i) Define Proportional and non proportional damping ii)Solve for damping ratios for the case of proportional damping	
		e	i) Decouple equations of motion using separation of variables ii) Solve for the response using mode shapes and generalized coordinates iii) Solve response of a large DOF systems in terms of first few modes and generalized coordinates	
8	Use various vibration measuring equipment	**a**	Use function generator to generate a periodic wave and use the analyzer to measure the Fourier components.	F-34, F-35
		b	i) Measure natural frequency of a SDOF system using impact hammer, accelerometer, and FFT analyzer ii) Measure damping ratio using half power points	

			iii) Understand various sources of error including digital signal processing issues and effect of sensors.	F-35, F-36, F-38
		c	i) Measure natural frequencies and mode shapes of a 2DOF system using impact hammer, accelerometer, and FFT analyzer. ii) Use imaginary part of transfer functions to obtain modal parameters. iii) Obtain damping ratios	F-37 F-39

9	Use commercial software such as Matlab	**a** **b**	Reconstruct a periodic wave from first few harmonics and plot using Matlab To solve for complete solution for response of a SDOF using Matlab	
		b	Solve for eigenvalues (square of natural frequencies) and eigenvectors (mode shapes) of undamped 2DOF and MDOF systems using eig command	
		c	Solve equation of motion for a 2DOF system such as automobile using state space method.	
10	Design a structure to prevent failure from vibration	**a**	i) Formulate equation of motion of SDOF system and suggest appropriate stiffness/damping for desired vibration isolation ii) Formulate equation of motion of 2DOF systems and suggest appropriate stiffness/damping for desired vibration isolation	

		b	Design a tuned absorber system for vibration prevention at a resonant forcing frequency while satisfying design constraints such as maximum displacement	
11	Solve for forced vibration of a SDOF system due to general forcing functions.	**a** **b** **c**	Identify various sources of periodic forces and use Fourier analysis to solve for response of SDOF system subjected to periodic force Identify various sources of transient forces and solve for response of SDOF system subjected to the transient forces Define response spectrums and discuss their use in structural design.	

B.9.e.5: TECH 344-Materials and Processes in the Plastics Industry (Explanation in B.9)

Student Learning Objectives and Outcomes				Assessments: Test Alignments Midterm (M) & Final (F)
	Student Learning Objectives/Outcomes-Major		**Student Learning Objectives - minor**	**Corresponding Tests and Test Items**
A.	**Students will Describe the Fundamental Structure of Plastics:**	**1.**	Students will draw & explain basic organic molecules.	
			a. Students will label the atoms and bonding types.	M1,M2,M3,M4
			b. Students will differentiate & give examples of alkanes, alkenes, alkynes, and aromatics.	M10,M12,M14 F11,F13
		2.	Students will interpret & draw polymer chains.	M16,M17,M18,M19,M20,M21
			a. Students will compare polymerization reactions.	M23
			b. Students will compare & contrast functional groups & tacticity.	M24
			c. Students will describe chain topology.	M26
		3.	Students will compare & contrast structure & applications of thermoplastics & thermosets.	M27,M28,M29,M30,M31
			a. Students will select commodity and engineered plastics.	M33,M34
			b. Students will differentiate crystalline & amorphous plastics.	M37
		4.	Students will name, draw, and label elastomers.	
			a. Students will explain elastomers.	M38
			b. Students will summarize polyisoprene.	M44
			c. Students will select & qualify other elastomers.	M45
B.	**Students will Predict Plastics Properties:**	**1.**	Students will describe effects of structural features on plastics properties.	M46

			a. Students will quantify & solve molecular weight distribution. **b.** Students will qualitatively evaluate crystallinity effects.	M48 M49
		2.	Students will state force and stress vs. strain relationship. **a.** Students will name & illustrate forces. **b.** Students will subdivide stress-strain curves. **c.** Students will compare stress-strain curves for different plastics.	 F50 F51 F52
		3.	Students will distinguish & explain mechanical, physical, thermal, environmental, electrical, and optical properties. **a.** Students will select ASTM techniques.	F53,F55,F56,F57,F58,F60,F61, F62,F64,F54,F59,F63 F65
		4.	Students will explain interactions of modifiers. **a.** Students will classify additives, fillers, & reinforcements.	 F66,F67,F68,F69,F70,F71,F72
C.	**Students will Describe Plastics Design and Finishing Processing:**	**1.**	Students will differentiate design methods.	F73
		2.	Students will classify ways of assembling plastics. **a**. Students will select machining methods.	F75,F76,F77,F78.F74 F79
		3.	Students will explain methods of finishing plastics. **a.** Students will give examples of joining & decorating.	F80,F81 F82,F83,F84
		4.	Students will compare & contrast rapid prototyping procedures.	F85,F86
D.	**Students will Observe Plastics Processing Techniques:**	**1.**	Students will recite observed processing methods.	F87

E.	**Students will Recognize the Environmental Aspects of Plastics:**	**1.**	Students will recite recycling codes.	F88,F89,F90,F91,F92
		2.	Students will explain waste reduction techniques. **a.** Students will evaluate source control, recycling, regeneration, degradation, landfills, & incineration.	F93,F94,F95,F97,F96
F.	**Students will Analyze, in Depth, Specific Plastics Topic:**	**1.**	Students will construct the history of a plastics topic, or	
		2.	Students will differentiate a plastic, or	
		3.	Students will detail a plastics processing method, or	
		4.	Students will describe, in detail, a plastic product.	

STUDENT ASSESSMENT SUMMARY
Jule Dee Scarborough, Ph.D.
(See Portfolio Sections B.9.a,b,c,d, and B.9.e.1-5; also, A.5 and A.7)

The goals of this program component were to diversify assessment so students had a wider range of types of assessments and more opportunities to provide evidence of learning – a multifaceted student assessment plan for the course. Another goal was to improve the quality of the midterm and final exams by designing them to incorporate a wider range of types of items and improving the problems to be solved, adding more specific grading criteria. Also it was important to measure the capability of the assessments to engage students at the upper levels of Bloom's Cognitive Dimension, as tests and other assessments can be designed at a much greater quality level when using Bloom's Cognitive Dimension to determine if the questions stimulate higher level thinking to reveal a deeper understanding of the concepts, principles, knowledge or skills. Finally, there was an additional goal of adding three formal performance assessments, with the corresponding rubrics for scoring performance of each, to the assessment plan. The above tasks were all accomplished, and once completed, the professors analyzed each assessment procedure against Bloom's Cognitive Dimension.

Test Analysis and Development
During the course analysis program component, the professors performed analyses of their midterm and final exams to use for diagnostic purposes – for the improvement of the tests and instruction. The test analyses were used to design and develop new midterms and final examinations for the 2006 course to be taught during the experimental research semester. Therefore, regarding the timeline, the test analyses were performed after the course, teaching, and learning analyses were completed. (See the GAPS Analysis in Portfolio Section B.5 for those results.)

After identifying the strengths and weaknesses of the tests used in the 2005 course, the professors then developed new Student Learning Outcomes for the 2006 course, as described in the previous Outcomes section. In the "Reversed and Intentional Instructional Design" process, the Outcomes define the "what" is to be learned and then what type of assessments are to be used for measuring student learning is determined. This answers the question "what is acceptable evidence of learning?" The professors designed and developed new objective midterm and final examinations; some professors included subjective items as well. (Refer to the section following this summary to read the analysis results for the 2005 tests as compared to the new 2006 tests, Portfolio Section B.8.2.)

Briefly, many of the professors included mathematical problems on their 2005 tests, some had objective items, and a few had no objective items. The range of types of tests varied across professors. The strength of some tests might be the problems, except that there were no grading criteria or rubrics with standards or criteria of performance. Therefore, the grading of problems was not perceived as consistent nor could it be determined exactly what professors were seeking beyond the "right" answer. Some professors did give points along the way for "right" partial elements of solutions; others did not. The grading was far too unspecified and far too subjective to really mean much. Also the point distribution or grade distribution was not formulated based upon objective criteria. Finally, for most of the

courses, the tests seemed to be the primary student assessments, with very few (possibly homework) other opportunities to further assess student learning. Several did include design projects, but these also were missing formal grading formula, criteria, or rubrics. Once again the grading was perceived as far too subjective, and the potential inconsistencies and lack of formal and predetermined objectivity left grading ambiguous. Professors lacked a multifaceted assessment plan for their courses where students were assessed for learning using a variety of types of assessments. They also provided few opportunities for students to demonstrate evidence of learning, meaning that, there were not very many assessments. Students are at a real disadvantage where there are very few assessments.

Once the 2005 test analyses were completed and we determined that there were no performance assessments in any of the courses, the professors designed and developed new midterm and final exams for the 2006 course. Using the results of those analyses diagnostically and the new 2006 student learning outcomes, the professors developed a Table of Specifications to guide their creation of a new midterm and final exam for the 2006 course. They each developed an objective test item bank of multiple questions for each student learning outcome. Once the objective test items were developed, they chose items for each exam, midterm and final, and assembled the tests. If they preferred to include problems to solve, those were added as well. The program leaders provided feedback throughout the entire analysis and development process. To further ensure that the test items and assembled tests actually measured knowledge or skills inherent in an outcome, the professors mapped the outcomes to the corresponding tests and specific items. This helped them realize where they needed more items or a different type of item and, especially, where there were gaps in the measurement of critical outcomes. (See worksheet below and other examples in B.9.2.e.1-5.) Although the tests were not perfect, they were greatly improved. (See Portfolio Section B.9.a for the comparison for differences between the 2005 and 2006 tests; see Program Description, Portfolio Section A.7, for further information on the Test Analysis and Development program components.)

An example of the outcome to test and test item analysis is copied here.

Table B.9.1: IENG 475 - Decision Analysis – Regina Rahn

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HW #3 (B,C)
HW #4 (D)
HW #5 (E)
Performance Task #1 (A)
Midterm # 1-18 (A)
Midterm # 19-21(B)
Midterm # 22-30 (C)
Final # 19-22 (A)
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</table>

Performance Assessment (See B.9.b and c; also, A.5 and A.7)
The second major program component related to student assessment was Performance Assessment. Each professor developed three performance tasks and corresponding rubrics. One performance task/rubric corresponded with the midterm examination and a second corresponded with the final exam. The third performance task/rubric use and focus was determined by the professors. Why design the two performance tasks to correspond to the midterm and final examinations – because the underlying premise that we chose to accept was that "most" or "typical" tests, at best, provided evidence of what students may "know about" or "know" at the lower levels of Bloom's Cognitive Dimension (memorize or limited comprehension). We do acknowledge that good tests may achieve these Bloom's levels, but tests do not "usually" provide the opportunity for students to apply, analyze, evaluate, synthesize or create. Furthermore, if well designed and developed problems are used, either for students to solve with established performance criteria for judging performance or to have to figure out before responding to a selection of provided responses, then these well designed and developed tests can accomplish the goal of providing high quality evidence of learning. But developing such tests really requires knowledge and skill in test analysis and development, as well as a great deal of time. When considering that most engineers and technology professors, as well as most of the university population of professors, have little to no background in educational or learning theory or in student assessment, then the reality is that most tests may not measure anything of significance very well or provide any worthy evidence of learning. Therefore, if one accepts that well designed and developed performance tasks (authentic and real world), with high quality and well defined performance criteria through the use of rubrics, can provide a greater opportunity for students to provide evidence of what they can "do" with the knowledge and skills, then performance assessment extends the evidence of learning possibilities. However, performance tasks and objective tests, even with good problems, can measure some similar things, but also very different knowledge and skills. Thus, we wanted the performance tasks to relate, but also to extend the evidence learning to include "doing" or "performing." We had hoped to consider the difference and similarities between the two types of measures, a good study in itself if formally executed. But we realized that the professors did not have background enough in assessment or the theory needed to design such research as this point in their experience. However, this was our way of introducing performance tasks/rubrics while also asking the professors to improve their tests. Some of the professors did not have objective test items at all on their tests; there were just subjective problems to solve without any established performance criteria. We wanted them to understand that if they were going to use solving a problem as a high quality performance, then they had to go the next step and develop a rubric that revealed the performance criteria for solving the problem, making it clear to both the student and the professor what the standards and criteria of performance could be. This also helped them to understand that they needed to grade more than just the end result or answer, that problem solving was a process that resulted in an answer.

For this first venture into performance assessment, we required three "complex" performance tasks, where each performance task was actually a cluster of several performances, was authentic, and reflected real world tasks, and the rubrics revealed levels of possible standards for performance and the criteria for each standard. Each professor developed the three performance tasks with corresponding rubrics.

Both professors and students reported liking performance assessment. The first ones were somewhat simple, but that will change as the professors continue to modify them and become more skilled at developing the tasks and rubrics. All professors reported that they will continue to use performance tasks and rubrics. This type of assessment greatly improved their overall course-student learning assessment plans, further diversifying the types of assessment for the course. Performance tasks also added more opportunities to provide evidence of learning. (See the Assessment Plan Maps included below, example and professors'.) Finally, each professor studied his/her overall tests, performance tasks, and any other types of assessment they included (e.g., design projects, collaborative projects, etc.) and analyzed them for achieving the higher levels on Bloom's Cognitive Dimension. There was a greatly improved range of Bloom's upper levels. For most of the professors, the tests achieved well to the application level, with three midterms and finals achieving the analysis and synthesis levels. Clearly, progressing to the inclusion of formal performance tasks moved the assessment plans to the higher levels of Bloom's Cognitive Dimension.

The Chart has been copied into this document below for reader convenience.

Table B.9.2: Bloom's Learning Taxonomy –Assessment Analysis Chart for 2006

CITL Professors **(numerical reported in %)**

Assessment		Knowledge	Comprehension	Application	Analyze	Synthesize	Evaluate
		Remember	Understand	Apply	Analyze	Evaluate	Create
Midterm	(1)	15%	30%	7.5%	7.5%	35%	None
	(2)	1	15	7	69	7	None
	(3)	5	35	45	10	5	None
	(4)	10	35	50	5	None	None
	(5)	None	10	50	40	None	None
	(6)	8	38	54	None	None	None
	(7)	30	70	none	none	none	none
Final	(1)	none	24%	none	12%	24%	46%
	(2)	2	14	8	76	None	None
	(3)	NR	NR	NR	NR	NR	NR
	(4)	5	30	55	10	None	None
	(5)	None	10	50	30	10	None
	(6)	4	35	61	None	None	None
	(7)	30	70	none	none	none	none
Performance Task 1	(1)	10%	10%	10%	20%	20%	30%
	(2)	None	None	10	30	30	30
	(3)	None	None	None	50	50	None
	(4)	None	None	None	None	100	None
	(5)	None	None	20	20	50	10
	(6)	None	None	None	None	50	50
	(7)	None	none	none	none	50	50

Assessment	Knowledge	Comprehension	Application	Analyze	Synthesize	Evaluate
	Remember	Understand	Apply	Analyze	Evaluate	Create
Homework (1)	**none**	**40%**	**5%**	**30%**	**10%**	**15%**
(2)	**10**	**20**	**30**	**40**	**none**	**none**
(5)	**None**	**30**	**50**	**20**	**None**	**None**
(6)	**None**	**40**	**30**	**30**	**None**	**None**
(7)	**X**	**X**	**none**	**none**	**none**	**none**
Lab Experiments (2)	**none**	**20**	**40**	**30**	**10**	**none**
<u>Miscellaneous:</u>						
Individual Assessments (4) (6)	**none**	**none**	**none**	**33**	**33**	**33**
Group Assess-Ments (4) (6)	**none**	**none**	**none**	**33**	**33**	**33**
Group Discussion (5)	**None**	**None**	**20**	**50**	**30**	**None**
Round Table Discussion (5)	**None**	**None**	**20**	**50**	**30**	**None**
Oral Presentation (5)	**none**	**none**	**none**	**10**	**40**	**50**

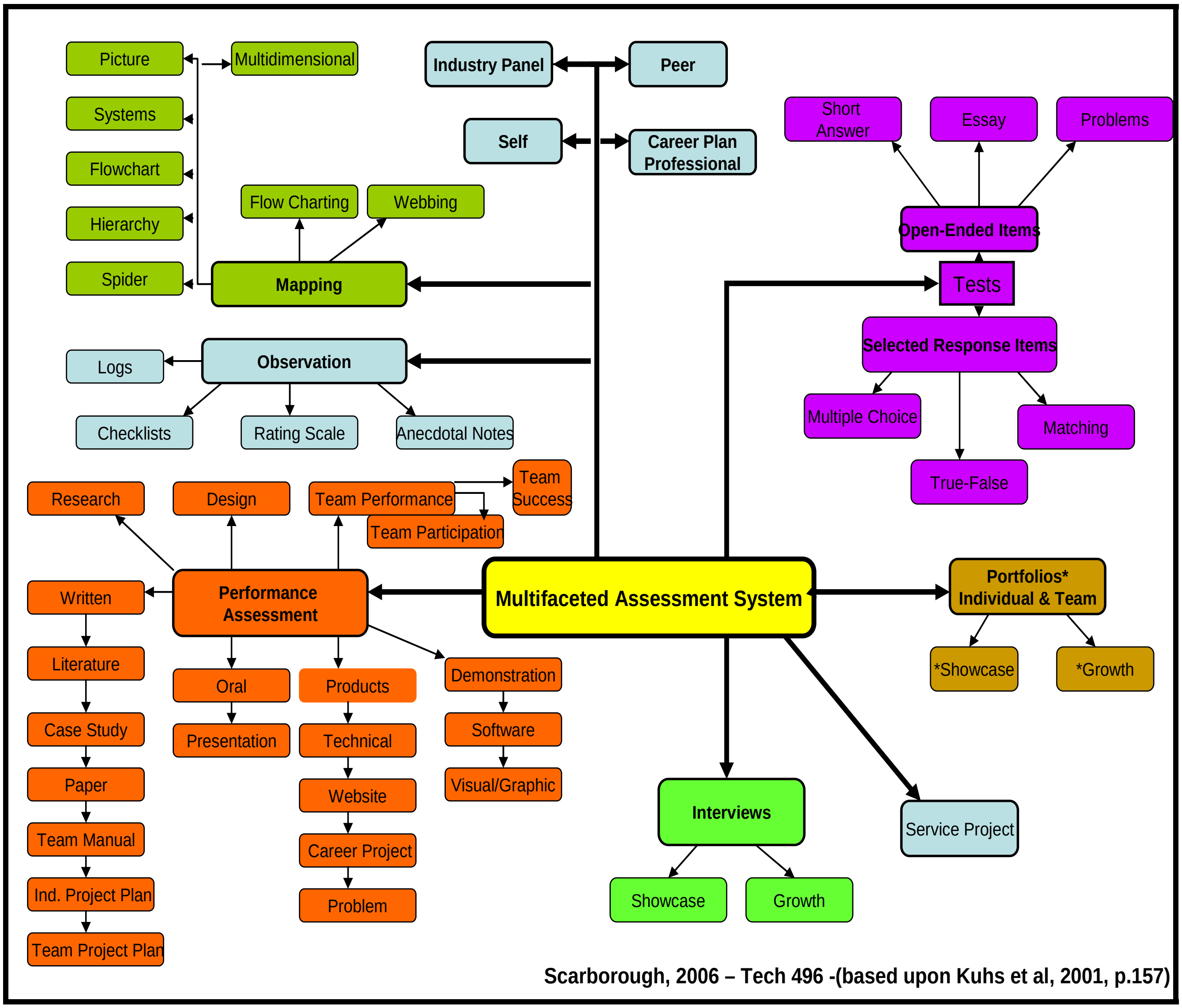
During the 2006 experimental research semester, the professors used their new assessments to measure and provide evidence of student learning. After the midterm and final exams, they performed an analysis, as they did initially with the 2005 tests. This process moved them into further use of test analysis for diagnostic purposes to improve tests, instruction, and student learning. They also performed their first diagnostic review of the performance tasks, qualitatively, to determine strengths and needed improvements. Both of these processes will assist them in improving the assessments for the next course offering and further instill the best practices of test analysis for diagnostic purposes, the use of performance tasks/rubrics, and the analysis of the performance tasks/rubrics (also for diagnostic purposes) to improve assessment and instruction, and ultimately student learning.

This was a successful program component, and there was significant gain in knowledge and skills by all professors. See following sections:

- **Bloom's Analysis of Assessment Plans** **(copied into this document above)**
- **Final Report: Discussion of Professors' 2005 and 2006 Test Analyses and Tests (See B.9.a)**
- **Professor Diagnostic Analyses of their 2006 midterm and final exams. (See B.9.d)**
- **Professors' Multifaceted Assessment Plan Graphics (samples are copied into this document below) The Maps are based upon Kuhs et al. (2001) and Scarborough (2006) modifications for the Faculty Development Program (Tables B.9.3). The Program sample is below, followed by each of the Faculty participants (Tables B.9.4-9).**

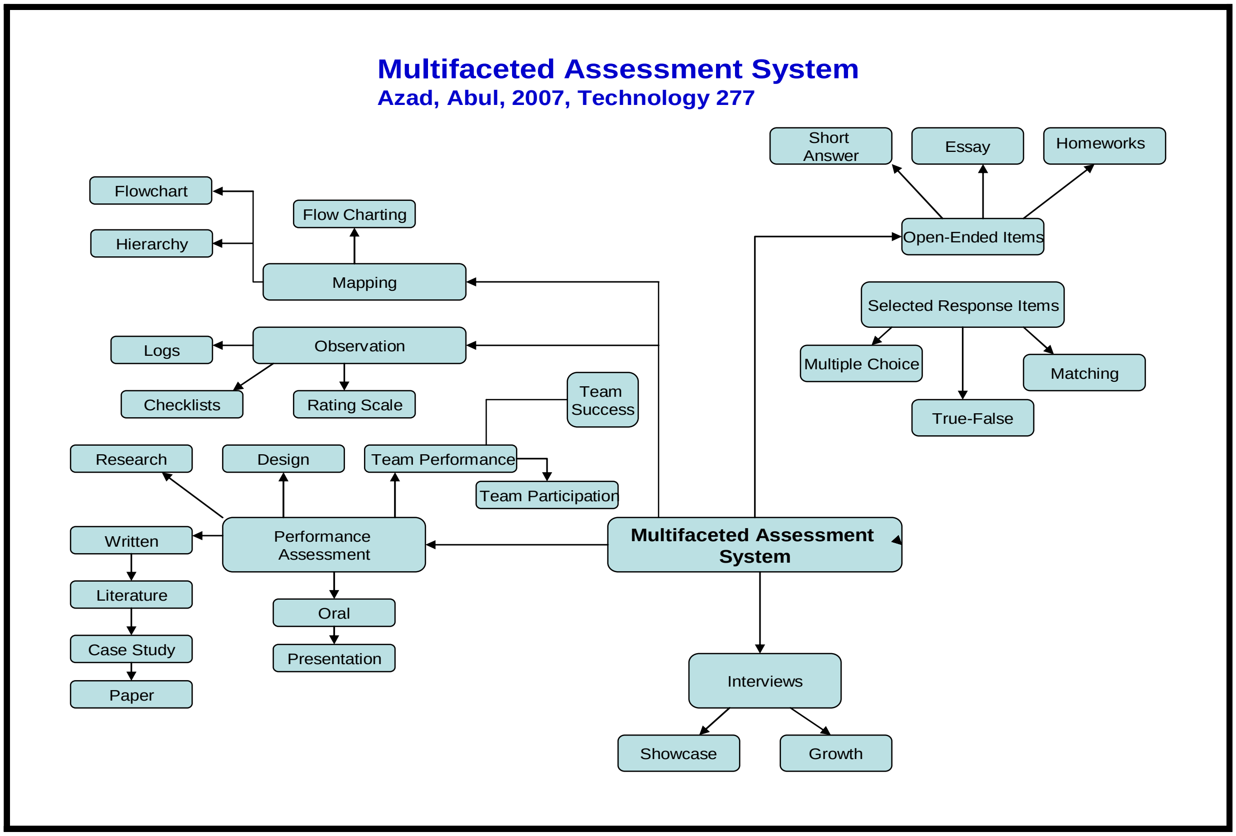
Note: We were going to explore studying the correlations between the Objective Tests and the Performance Assessments. We did compute the correlations, but the research considerations were too complex to consider. However refer to B.9.c for the discussion.

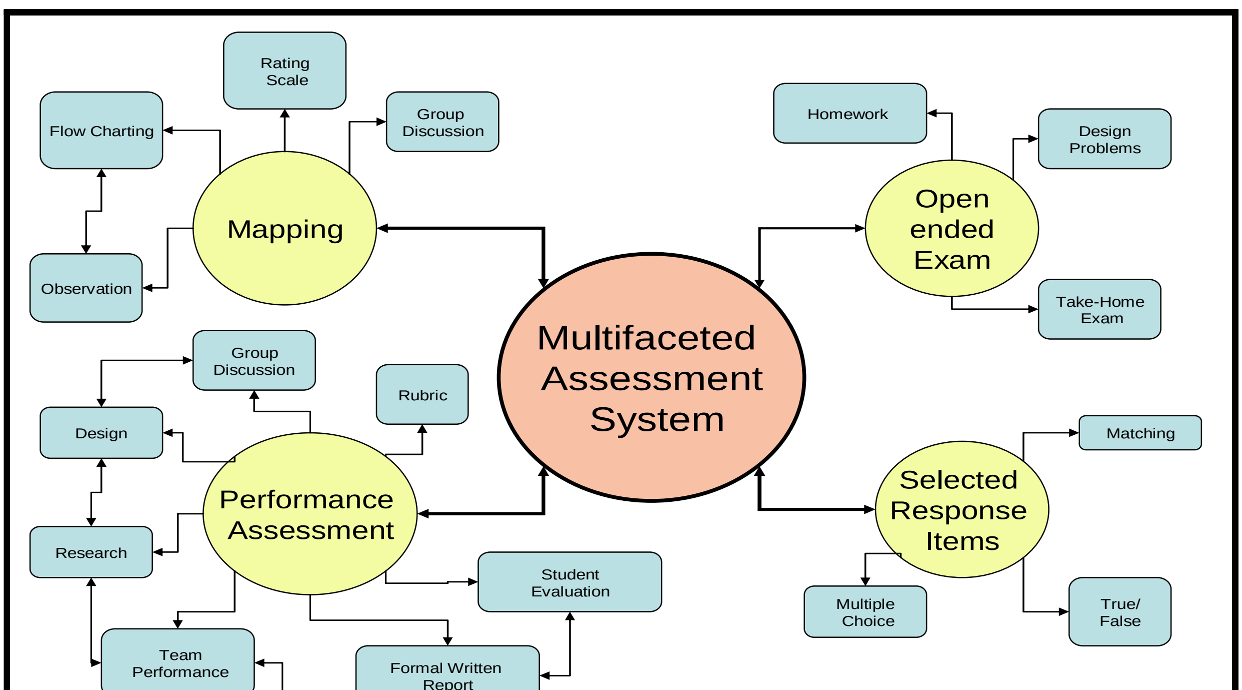
Table B.9.3



CEET Professors 2006 Multifaceted Assessment Plans

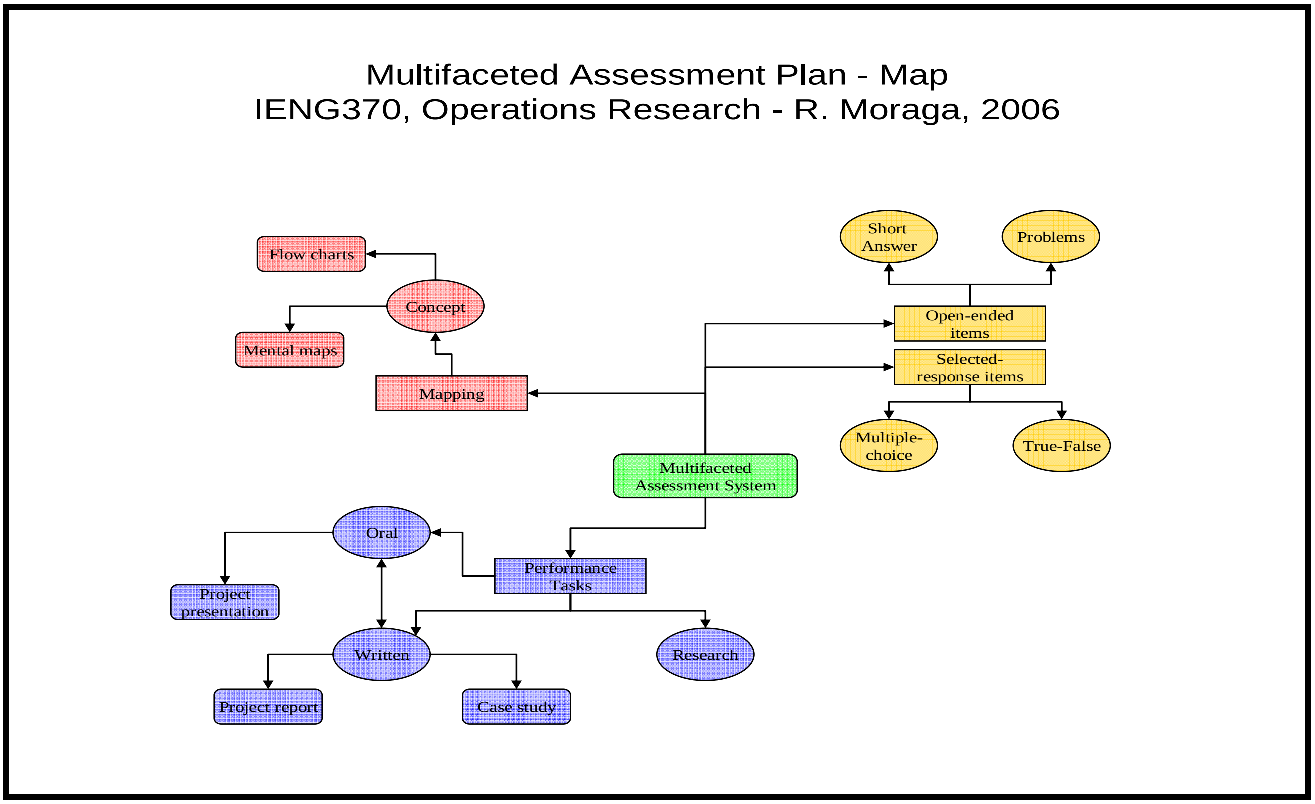
Maps based on Scarborough, 2006 and Kuhs et al, 2001

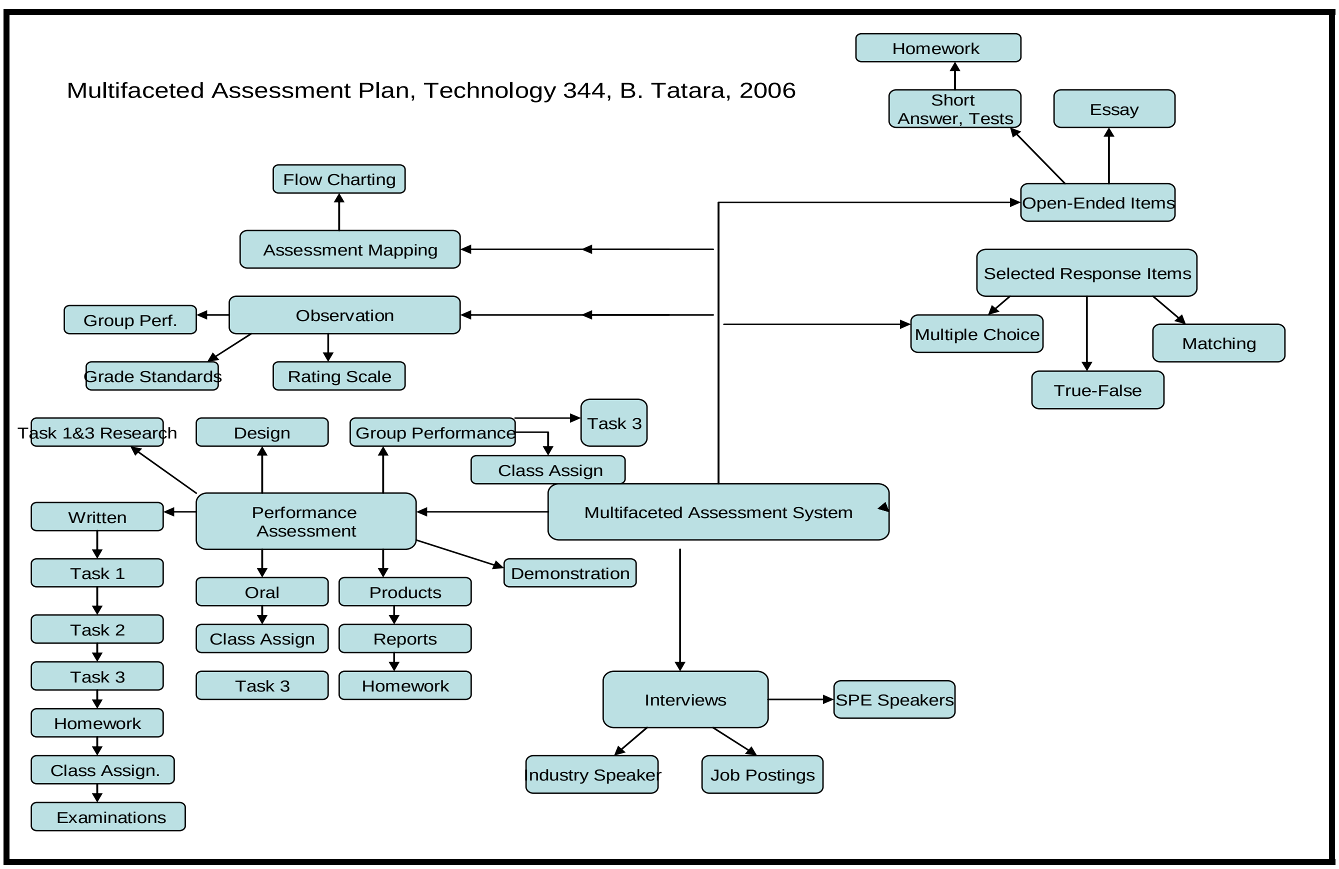


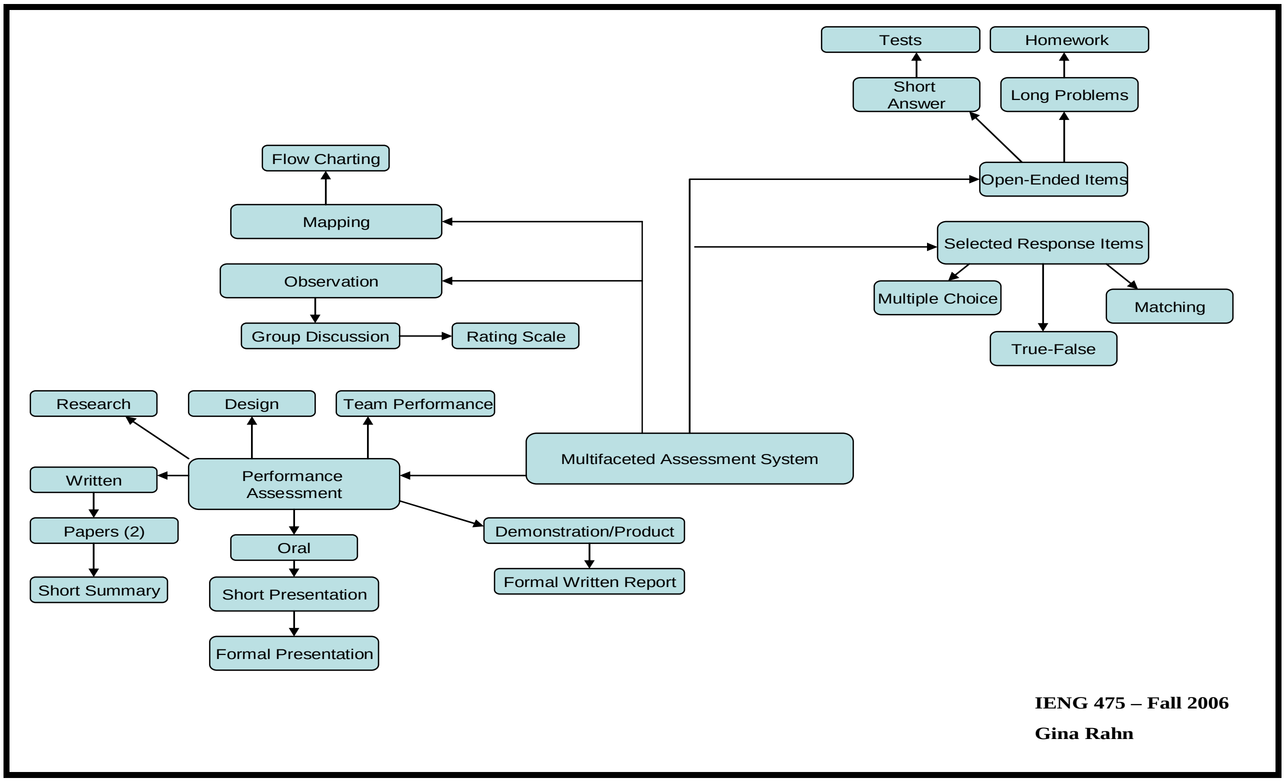


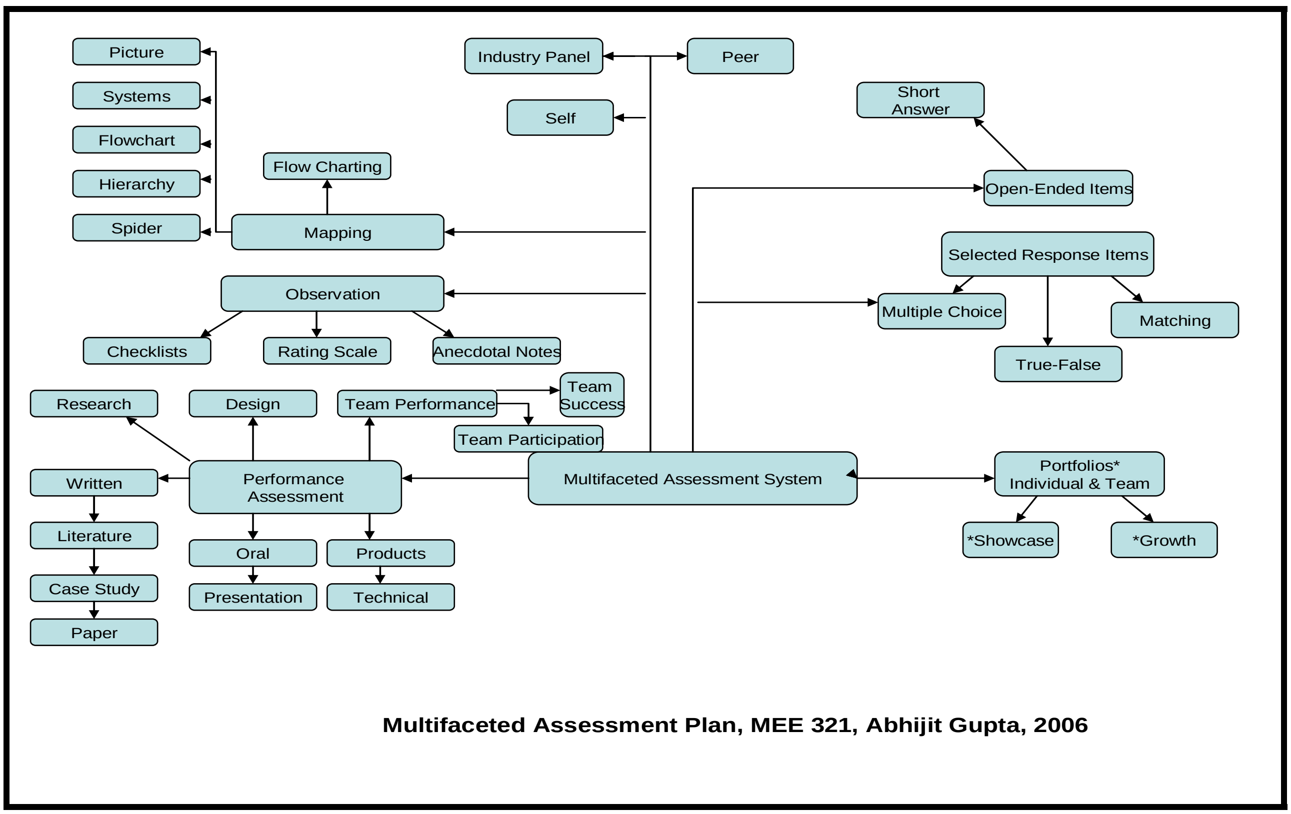
ELE 335 – Fall 2006

Ibrahim Abdel-Motaleb


Multifaceted Assessment Plan - Map
IENG370, Operations Research - R. Moraga, 2006
Flow charts
Concept
Mental maps
Mapping
Short Answer
Problems
Open-ended items
Selected-response items
Multiple-choice
True-False
Multifaceted Assessment System
Oral
Performance Tasks
Project presentation
Written
Research
Project report
Case study


Multifaceted Assessment Plan, Technology 344, B. Tatara, 2006
Homework
Short Answer, Tests
Essay
Flow Charting
Open-Ended Items
Assessment Mapping
Selected Response Items
Group Perf.
Observation
Multiple Choice
Matching
Grade Standards
Rating Scale
True-False
Task 1&3 Research
Design
Group Performance
Task 3
Class Assign
Written
Performance Assessment
Multifaceted Assessment System
Task 1
Oral
Products
Demonstration
Task 2
Class Assign
Reports
Task 3
Task 3
Homework
Interviews
SPE Speakers
Homework
Class Assign.
Industry Speaker
Job Postings
Examinations


Tests
Homework
Short Answer
Long Problems
Flow Charting
Open-Ended Items
Mapping
Selected Response Items
Observation
Multiple Choice
Matching
Group Discussion
Rating Scale
True-False
Research
Design
Team Performance
Multifaceted Assessment System
Written
Performance Assessment
Papers (2)
Oral
Demonstration/Product
Short Summary
Short Presentation
Formal Written Report
Formal Presentation
IENG 475 – Fall 2006
Gina Rahn


Picture
Industry Panel
Peer
Systems
Self
Short Answer
Flowchart
Flow Charting
Hierarchy
Open-Ended Items
Spider
Mapping
Selected Response Items
Observation
Multiple Choice
Matching
Checklists
Rating Scale
Anecdotal Notes
True-False
Research
Design
Team Performance
Team Success
Team Participation
Written
Performance Assessment
Multifaceted Assessment System
Portfolios* Individual & Team
Literature
Oral
Products
*Showcase
*Growth
Case Study
Presentation
Technical
Paper
Multifaceted Assessment Plan, MEE 321, Abhijit Gupta, 2006

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Abhijit Gupta
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Regina Rahn
Robert Tatara

I Love Teaching at NIU

Volume III: Program Worksheets; Forms; and Instruments

Northern Illinois University

The Scholarship of Teaching
The CEET Initiative on Teaching and Learning

Jule Dee Scarborough, Initiative Director

College of Engineering and Engineering Technology
Promod Vohra, Dean

Program Associate: Jerry Gilmer, Director, NIU Testing Services
Editor: Gail Jacky, Director, NIU Writing Center

October 2005-December 2006

Discipline Course Outline

Course Disciplinary Content	**Science(s) Foundation Required** (Id. Physics, Chemistry, Biology, etc.)	**Mathematics Foundation Required**	**Communication Foundation/ Skills Required**
I. Unit			
A.	A. Physics, Chemistry, Bio?	A.	A.
		1.	1.
1.	1.		
2.	2.	2.	
B.			
1.			
2.			
C.			
1.			
2.			
II. Unit			
III. Unit			
IV. Unit, etc.			

Table C.1.2 : Content Schedule and Styles, Models, Bloom's Analysis

Week	**Content Topic:** *Factual, Conceptual, Procedural, Meta-cognitive*	**Content Source** *Text, etc.*	**Teaching Style** *a-k; fpfd*	**Learning Style** *CE, AE, AC, RO*	**Teaching Model** *1-24 name*	**Dale's Cone** *Active or Passive*	**Bloom's Traditional:** *Evaluation, Synthesis, Analysis, Application, Comprehension , Knowledge*	**Bloom's Revised** *Create, Evaluate, Analyze, Apply, Understand, Remember*	**Critical Thinking**	**Centered?** *Teacher, Knowledge Assessment, Learner*
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16	Final Exam or Project									

Note: There is a practice by some professors to give the final exam before or during the **last week of CLASS**, rather than the **FINAL EXAM WEEK**. This essentially means that you are "cheating" the students out of one day of content, learning, etc. We should have 15 weeks of learning, including exam, quizzes, or project days, but to make the **final week of class** the **FINAL exam week** is unethical by NIU standards, regardless of who does it. **What is your practice?**

Table C.1.3: Content Schedule and Styles, Models, Bloom's Analysis

Week	**Content Topic:** *Factual, Conceptual, Procedural, Meta-cognitive*	**Content Source** *Text, etc.*	**Teaching Style** *a-k; fpfd*	**Learning Style** *CE, AE, AC, RO*	**Teaching Model** *1-24 name*	**Dale's Cone** *Active or Passive*	**Bloom's Traditional** *Evaluation, Synthesis, Analysis, Application, Comprehension ,Knowledge*	**Bloom's Revised** *Create, Evaluate, Analyze, Apply, Understand, Remember*	**Critical Thinking**	**Centered?** *Teacher, Knowledge Assessment, Learner*
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										

12										
13										
14										
15										
16	Final Exam or Project									
Note: There is a practice by some professors to give the final exam before or during the **last week of CLASS**, <u>rather</u> than the **FINAL EXAM WEEK**. This essentially means that you are "cheating" the students out of one day of content, learning, etc. We should have 15 weeks of learning, including exam, quizzes, or project days, but to make the **final week of class** the **FINAL exam week** is unethical by NIU standards, regardless of who does it. **What is your practice?**										

Table C.1.4: Instructional Design Gaps Analysis Table

ABET/ NAIT Standard **a-k Eng** **A-Q Tech**	**NIU General Ed Goals** **(embedded)** **a-I, ii, iii, iv** **b-I, ii, iii, iv** **c and d**	**Student Learning Objectives listed on syllabus**	**Bloom/Dale** ***Evaluation/Active*** ***Synthesis/Active*** ***Analysis/Active*** ***Application/Active*** ***Comprehension/P*** ***Knowledge/Passive***	**Knowledge Sources** **Professor, Text, Cases, Speaker, References, etc.**	**Student Assessments listed on syllabus**	**Bloom/Dale** ***Evaluation/Active*** ***Synthesis/Active*** ***Analysis/Active*** ***Application/Active*** ***Comprehension/P*** ***Knowledge/Passive***	**Test Items or Projects/ Rubrics**	**Bloom/Dale** ***Evaluation*** ***Synthesis*** ***Analysis*** ***Application*** ***Comprehension*** ***Knowledge***	**Performance** ***IF any; if none, leave blank***	**Bloom/Dale** ***Evaluation/Active*** ***Synthesis/Active*** ***Analysis/Active*** ***Application/Active*** ***Comprehension/P*** ***Knowledge/Passive***

PROFESSORS -- *READ OUT LOUD CAREFULLY* *to students before handing out questionnaires.*

To: Participating students
Fr: Dean
Re: New initiative to study the quality of instruction, course content, and the learning environment across the college

The following questionnaire is being administered to selected classes across the college and its four departments. As students in those classes, you are being asked to participate in providing baseline information about the quality of instruction, course content, and the learning environment in the college. It is important to take note of the following:

(a) The first part of the questionnaire relates only to this course.

(b) The second part of the questionnaire relates to your experience across all the courses you have taken in your major department.

(c) This questionnaire **does not seek** information about your experience in any courses outside the major department, e.g. general education or courses transferred to NIU.

Your responses to these questions will be used as baseline information to study how to strengthen the quality of education across the college.

We are hoping that you will complete this questionnaire **thoughtfully, seriously, and genuinely,** with the understanding that **it is important** and **will assist us** in structuring a college initiative to study and strengthen the quality of instruction, course content, and the learning environment across the college.

In testing the questionnaire with students, it took about 20 minutes, therefore, we are allowing 30 minutes of class time to complete the questionnaire in class.

The questionnaire is somewhat long, but not as long as it may seem, because the questions have been written in a way that hopefully describe thoroughly what we are seeking information about. Also, the print is regular sized and we have spaced and printed the document for easier reading.

Please attend to each item carefully and respond to the best of your ability. We need your input. It is important that you respond honestly, genuinely, and with sincerity as the results of the survey will greatly impact the Dean's new initiative on the quality of education for students in the college.

Thank you for investing your time and serious effort to help us begin this very important initiative.

Course Questionnaire on Teaching and Learning

Jule Dee Scarborough (2006)

After completing the student and course information on the front side of the scan form, respond to the following questions on the back side of the form beginning with item 101.

Questions 101-124 focus on the course you are now ending. Please respond to 101-124 based upon your experience in <u>this course only</u>.

101. The course syllabus identified specific learning objectives.

a. Yes, and I understood them
b. Yes, but I didn't understand them
c. I don't know
d. No, there were no learning objectives

102. The learning objectives for this course were chosen or required by: (Select all that apply.)

a. Future employers
b. Department head
c. Professor's interests
d. Accreditation agency
e. NIU General Education Goals
f. I don't know

103. The course syllabus specified (Select all that apply)

a. course or student learning objectives
b. course description
c. clearly defined course content
d. clearly defined assignments, labs, papers, projects, tests, or other important assignments or activities
e. the course schedule or timeline identifying meeting dates, assignment due dates, and the semester's schedule
f. additional explanations of course requirements which established the criteria for each assignment
g. references other than the text (e.g., books, websites, articles, other sources related to course content)
h. contact information for professor, instructor, and/or graduate teaching or lab assistants

104. The professor (and any assistants) (Select all that apply)

a. focused content and learning activities on the course or student learning objectives throughout the semester
b. provided learning that seemed to align with the course description
c. taught the course content specified in the syllabus
d. followed the assignments, labs, papers, projects, tests, or other important assignments or activities outlined and defined in the syllabus
e. followed the course schedule or timeline specified in the syllabus (e.g., meeting dates, assignment due dates, and the semester's schedule)
f. graded assignments according to the written explanations for course requirements establishing the criteria for each assignment
g. were available using the contact information for professor, instructor, and/or graduate assistants
h. deviated from the syllabus by adding <u>appropriate</u> content to expand, deepen understanding, or resolve questions resulting in <u>adding value</u> to the course; any additional assignments were appropriate having reasonable timelines
i. deviated from the syllabus <u>inappropriately</u>, where additions to the information provided on the syllabus, or new assignments added were <u>irrelevant</u> or <u>distracting</u> and added <u>little or no value</u> to the course or learning; new assignments were untimely and caused unnecessary stress for students
j. The course was well organized, structured, and executed.

105. Which of the following methods were used by the professor to measure learning? (Select all that apply)

a. final exam - traditional test
b. midterm exam - traditional test
c. quizzes and/or short tests periodically-traditional test(s) (e.g., multiple-choice or true/false)
d. quizzes and/or short tests periodically - short answer and/or essay
e. research or learning paper (s), usually requiring literature search or field research and formal write-up
f. case study(ies) in industry, usually requiring a report or short paper write-up
g. hands-on technical project(s)
h. hands-on non-technical project(s)
i. other types of performances, "doing" something
j. course portfolio, full documentation of all work and progress in the course
k. 0ther; write a description here:

106. Select ALL the descriptions below that identify the methods being used in this course to measure student learning:

a. Learning was measured on my ability to memorize terminology, symbols, facts, information, theory, principles, concepts, information, definitions, descriptions

b. Learning was measured on my ability to make comparisons to determine similar and dissimilar examples, understanding relationships and connections between and among facts, concepts, theories, principles, translates knowledge into a new context, interpret facts, predict consequences, order, group information, contrast, distinguish, estimate, differentiate, discuss, or extend knowledge

c. Learning was measured on my ability to use information, methods, concepts, theories in new situations; problem solving - this requires choosing and applying knowledge (e.g., the best formula, concept, principle, theory to solve problems) and using inductive reasoning to determine the best methods, techniques, tools, and strategies to apply towards a best solution; this method of measurement can range from a test item with a complex problem to be solved or a hands-on technical problem, requiring the design and building of something mechanical. The key to this method is that it requires application of knowledge – "doing" (demonstrate, calculate, illustrate, show, solve, examine, modify, relate, change, experiment, discover)

d. Learning was measured on my ability to recognize patterns in information, problems, and situations; the ability to organize parts, identify or discover "hidden" meanings, identify components; this requires one to analyze, separate thoughts, processes, problems, order, explain, connect, classify, and divide, compare, select, explain, and make inferences (indirect meanings); this requires deductive reasoning where one begins with facts and information and makes choices to gradually discover the bigger picture

e. Learning measured my ability to hypothesize, design, support argument, schematize, write, report, justify, choose, evaluate, estimate, judge, criticize, defend, and use old ideas to create new ones, extending the old idea into a new one for extended applications and to make choices based upon reasoned argument, verify value of evidence, recognize when subjectivity is being used rather than objectivity (more scientific), make sound generalizations from given facts, relate and use knowledge across different contexts, predict and draw conclusions, combine, integrate, modify, rearrange, substitute knowledge, plan, formulate, compare and discriminate between, summarize, and make conclusions

f. Learning measured my ability to design, discover, invent, develop, create, research; transform knowledge into a product, process, technique, model, method, strategy, etc.

107. Select the response that best describes the <u>relationship</u> between the traditional <u>tests</u> you have taken to date in this course (e.g. multiple-choice, true/false items, etc.) and the <u>course content</u>.

a. the content of the <u>test</u>(s) **was related** to the content specified in the <u>syllabus</u> and <u>only to</u> content specified in the syllabus.

b. the content of the test(s) **was related** to the content specified in the <u>syllabus</u> **and** <u>other content</u> provided by the professor or assistants.

c. the content of the test(s) **did not relate** to the content specified in the <u>syllabus</u> **but did relate** the <u>other content</u> provided by the professor or assistants.

d. the content of the test(s) **related to <u>neither</u>** (1) the content specified in the <u>syllabus</u> **nor** (2) the <u>other content</u> provided by the professor or assistants.

Items 108-111 relate to the measurement of student learning through performance(s) <u>rather than</u> traditional tests. * Consider the <u>definitions</u> below when responding to items 108-111.**

***** Definitions:**
*****Performance Task (or assessment) -** *any authentic or real-world task designed to measure student learning. Such a task can be used to determine what students can "do" with knowledge. Unlike some traditional tests, performance tasks require students to move to another level of providing evidence of learning - that of applying or using knowledge by performing authentic tasks, such as designing a part or product, or designing and then producing the part or product. Writing a paper would provide evidence of research skills and communication skills, for example.*

(108) Performance tasks were used to measure student learning in this course. (*see definition above)
a. Yes (according to the definition above)
b. No (according to the definition above)

*****Rubric -** *any type of information sheet or form, check off sheet that establishes the levels of performance criteria for performance tasks; these criteria establish standards for performance and the criteria for each standard; they are used to provide students information about what is required to achieve a particular number of points or grade.* ***See attached example at end of questionnaire following this page; then continue to complete the questionnaire..***

(109) Rubrics were used for scoring or grading the performances in this course.
a. Yes (according to the definition below)
b. No (according to the definition below)

(110) Below are examples of some performance tasks. Identify any that are <u>similar</u> to performances that you had to accomplish during this course. Select all that apply:
a. Writing a paper
b. Working problems, showing the entire equation worked out manually, through each step of the equation
c. Designing a product part, entire machine, other major design project
d. Designing an industrial production system
e. Designing electrical circuitry or full electrical/electronic system
f. Designing and producing a part using manufacturing processes (e.g., actually producing product using manufacturing production equipment in a lab or on-site in industry)

(111) Select all examples of performance tasks below (s<u>imilar</u>) where a rubric or performance criteria <u>form</u> was used to score or grade the performance(s) during this course.

a. Writing a paper
b. Working problems, showing the entire equation worked out manually, through each step of the equation
c. Designing a product part, entire machine, other major design project
d. Designing an industrial production system
e. Designing electrical circuitry or full electrical/electronic system
f. Designing and producing a part using manufacturing processes, e.g. actually producing product using manufacturing production equipment in a lab or on-site in industry

***INSERT RUBRIC COPIES for STUDENT VIEWING HERE

112. The following items related to levels of learning and how learning takes place. (Select ALL that apply)

a. the learning of basic knowledge requiring me to list, name, identify, show, define, recognize, recall, state, visualize, state facts, concepts, theories, principles, information?

b. the comprehension or greater understanding of knowledge through activities that required me to summarize, explain, interpret, describe, compare, paraphrase, differentiate, demonstrate, classify, or contrast facts, information, concepts, theories, and principles?

c. the application or opportunity to "do" or "perform" using knowledge, requiring me to solve problems, illustrate, calculate, use, interpret, relate, manipulate, apply, and/or modify facts, concepts, theories, information, or data?

d. analytical activities that required me to analyze and organize facts, data, and information; deduce patterns and trends; contrast, compare, and/or distinguish differences or similarities; and then discuss solutions, directions and plan or devise actions?

e. the synthesis and evaluation of facts, information, data, situations, problems, and furthermore require me to argue rationally, support or justify a method, solution, action, choice of formula, theory, concept, principle or result in the need to propose a hypothesis, following with the design of an experiment, product, process, technique, and/or make judgments that had to be critiqued and defended and finalized into reports, summaries, or papers.

f. the design, discovery, invention, development, creation, research, or transformation of knowledge into products, processes, techniques, models, methods, strategies, etc., using design and development, research, experimentation, and/or development knowledge, techniques, procedures, and tools?

113. This course engaged me in (Select one response)

a. learning knowledge and skills to use <u>when</u> I get a job.
b. learning knowledge and skills to use when I get a job, <u>but also</u> provided the opportunity <u>to apply</u> that knowledge in class through projects or activities where performing tasks using that knowledge were required
c. neither (a) nor (b), very well

114. The following list identifies and briefly describes teaching methods the professor may use during instruction. (Select all that apply)

a. the professor lectures information and connections; I listen and take notes, if I choose

b. the professor focuses or presents content, breaks the class into student groups to discuss the content, and then engages in summarizing and clarifying the content as a group.

c. the professor focuses or presents content and then assigns individual but short term projects using the content or information (e.g., problem to solve, design project, analysis).

d. the professor focuses or presents content, breaks the class into student groups to discuss the content, and then engages in a short term group project using the content or information (e.g., problems to solve, design project, analysis)

e. lessons are broken down in components; as individual students master each component, they are tested; when they pass the test, they go on to the next component.

f. the professor uses visual charts, displays, and/or a wide range of graphic organizers or other visuals to better organize and present information, to show relationships between concepts, principles, to increase understanding about the application of foundation concepts or principles.

g. when presenting content, the professor uses examples that are and are not representative of the concept or principle. Students compare the examples and match those that represent the concept or not; gradually, as more examples that are and are not representative are reviewed, the group reaches consensus of what examples directly represent the content and come away with greater understanding.

h. lessons require that we combine concepts and analyze the relationships of concepts; we then engage in solving problems.

i. during the lessons, the professor asks us to identify and enumerate information related to concepts as they are demonstrated, grouping concepts into categories with common attributes.

j. we learn information on concepts through the act of classification, gathering and classifying information to build and test hypotheses; they engage in experiments and the results of experiments are used to develop hypothesis generalizations about the situation, idea, or problem.

115. The following list identifies and briefly describes additional teaching methods the professor may use during instruction. (Select all that apply)

a. students are presented with generalizations and examples and engage in trying to identify the individual situation or idea that is embedded (move from problem to why something happens)

b. students are presented with a problem and then create questions to be used to solve the problem. Students engage in a process of investigation and explanation of the phenomena.

c. students engage in a formally organized court case to present information and arguments about the ingrained issues.

d. students are instructed on each component of the content, and all must be successful on that content before the professor moves on with new or more complex content

e. lessons break skills down into components and sequences of action; each person learns the skill step by step the same way

f. lessons begin by focusing on a current situation; analogies are used to define the characteristics of the situation; analogies continue, using other graduated analogies until it appears to have no relationship to the origin; the lesson then uses the final description of the analogy to compare to the original situation

g. lessons engage us in the development of physical skills, such as welding

h. the professor uses metaphors to make content more familiar

i. lessons focus on personal development, free expression of ideas and feelings, furthering your self-understanding

j. students explore problems through actions developing problem solving skills; we participate and/or observe

116. My professor exhibited the following styles of instruction throughout the semester. (Select all that apply.)

a. professor makes all decisions on what, where, when, and how learning takes place; is the expert; strives for precision, synchronization, and uniformity; and determines what is taught and how it will be evaluated

b. students are given a number of tasks to do while in class; students can ask questions; professor moves around and gives feedback

c. students provide feedback to each other; one student performs while another provides feedback; professor designs forms to guide the observations; socialization is inherent in this style; students develop feedback skills

d. feedback is provided by you as the individual learner to yourself; other events providing external feedback facilitate your ability to do this; professor helps you become a better evaluator, thus, increasing your self-esteem about working independently

e. we select our own level of performance and alter it according to my/our self-evaluation; the professor determined the tasks and defined the levels of difficulty

f. professor leads students to discover concept by answering a series of questions; professor determines concepts and best sequences for guidance; friendly environment with time to think built into the learning opportunity; professor traces a series of questions leading to the answer

g. professor presents question; students use logical and critical thinking to discover solutions; students determine questions to ask rather than the professor; professor respects the student process and does not interfere

h. professor encourages students to find multiple solutions to given problems; professor selects the subject and designs the problem; there is no one right answer; professor responds to student process rather than the value of a solution or answer

i. the student and professor selects the content to be learned; the student designs, develops, and performs the series of tasks **and/or** students select the activity, design the experiences, perform the tasks; professors assists/consults with the evaluation of tasks

j. students are empowered to take full responsibility for the learning process; they are not required to consult with the professor

117. Which of the following best describes this course?
Choose the one item that comes closest to describing your experience in this course.

a. The professor assumes the entire responsibility for delivering the course content. He/she lectures all information we are expected to learn. The text is used as a reference. Lectures reflect text content.

b. The professor assumes the entire responsibility for delivering the course content in combination with assigned readings from the textbook. The lectures and text content provide all the information we are expected to learn. Most lectures correlate directly or are duplication of text content.

c. Students are assigned reading from the text to gain basic course content. My professor explains difficult content from the text and then adds lectures on some important or critical content that is not covered in the text, thus expanding or deepening understanding and ability to use the information from the text.

d. Students are responsible for some of their own learning. For example, once a concept or principle is explained by the professor and we have used the text for basic learning, as a source or reference, we then have to perform research on content ourselves to deepen our understanding of the concept and its application possibilities. We have to bring the information back to class to share with the professor and class. Student activities can vary from literature research, case studies, identifying additional sources of information (e.g., books, people, examples, demonstrations, etc.). Students are required to learn on their own or in small groups to deepen understanding or extend learning and understanding beyond that presented by the professor or established learning activities.

e. The professor assigns reading from the text, explains difficult content, and then provides content to deepen or extend the basic text content or to clarify or explain content not well understood. Students are responsible for some of their own learning, and we then engage in research to solidify understanding of the content. Ultimately, the professor then assigns projects that expand learning into the "doing" dimension where we used the content learned to solve a problem, develop a product, construct a theoretical model, use materials, processes, and knowledge to create, etc.

f. Students are responsible for a great deal of their own learning. After working with us in a variety of ways, many of them are highly engaging students to learn important knowledge and skills, where the professor is more of a learning coach, direction setter, source of validation, someone who models an inquiry driven process of learning, with a strong focus on "how" and "why" processes. He/she provides the opportunity to engage in the creation of a solution to a identified need or problem applying the knowledge and skills learned earlier or throughout the learning processes throughout the semester.

118. This course provided the opportunity to work cooperatively in small groups to accomplish the learning of course content. (Select one)

a. Yes
b. No

119. When working together, we sought outcomes that benefited me individually as well as the whole group. (Select one)

a. Most of the time
b. Some of the time
c. Not really
c. No opportunity to work in groups

120. When working with others, I feel that we maximized my own learning and the learning of others. (Select one)

a. Most of the time
b. Some of the time
c. Not really
d. No opportunity to work in groups

121. Working in groups provided greater opportunity for everyone to learn more and resulted in higher grades for all. (Select one)

a. Most of the time
b. Some of the time
d. Not really
e. No opportunity to work in groups

122. When you were required to work in student groups throughout the course, were those group assignments formally organized with criteria for performance? (Select one)

a. Most of the time
b. Some of the time
c. Not really
d. No opportunity to work in groups

123. When you were required to work in student groups throughout the course, did the professor provide formal and specific team related instruction on how to function effectively and productively on a team?   (Select one)

a. Yes
b. No

124. Working in groups results in:
(Select as many as apply b-i; if you choose response a, move on to question 125)

a. there was no opportunity to work in groups
(**if you choose this selection, move on to question 125**)

b. higher achievement and productivity by all or almost all members of the group

c. longer term retention of knowledge being learned

d. intrinsic (inside myself) and higher motivation to achieve by all or almost all members of the group; greater focus and time on task

e. higher level thinking, reasoning, deeper analysis of problems, better judgments

f. more positive relationships between most students or among group members and more caring about each other's learning and success; feelings of more support in learning

g. greater value of diversity among group members; greater cohesion among students in the course

h. the development of higher self-esteem among most students; further development of self identify

i. development of social skills so that students learn to engage with each other in a positive manner, even when conflicting ideas are on the table

j. greater ability to cope with adversity and stress

125. The professor's language skills <u>were not</u> a barrier in communication between the professor and students.

a. <u>Strongly agree</u> - the professor's language skills were <u>exceptionally good</u>; very effective communication took place between the professor and students.

b. <u>Agree</u> - the professor's language skills were <u>good</u>; there was effective communication between the professor and students.

c. <u>Disagree</u> - the professor's language skills <u>need to improve</u> for effective communication to occur between the professor and students.

d. <u>Strongly Disagree</u> - the professor's language skills were <u>inadequate</u> for effective communication between the professor and students; poor language skills resulted in communication barriers between the professor and students.

Unlike Items 101-125 above which focused on THE course you are NOW in and completing, <u>the following questions are focused more broadly</u>.

<u>For Items 126-136, reflect on your experience across ALL the courses</u> you have taken in engineering and/or technology to date. Provide your perspective by <u>generalizing across ALL the courses</u> that you have taken in engineering and/or technology to date and respond to Items 125-135 below.

126. The <u>professors</u> teaching the engineering and/or technology courses that I've taken to date in my major: (Select one)

a. seem exceptionally competent and knowledgeable
b. seem competent and knowledgeable
c. seem adequate in their knowledge
d. professor's knowledge seems questionable

127. The professors <u>teaching</u> the courses that I've taken in engineering and/or technology teach in a way that: (Select one)

a. motivates me to want to learn and perform in those classes at a very high level; they keep me interested, excited, and make me realize that I have chosen the right field or career track for me

b. keeps me interested most of the time so that I perform above average most of the time

c. is difficult for me to maintain my interest in the courses; it is often difficult to remain interested all the way through each class. I feel I can read the book and take the tests and still perform well enough for an adequate grade

d. truly causes me to be less motivated to perform, making it almost impossible to remain interested in the courses or content being covered

128. The <u>learning environment</u> in the college and department <u>is positive</u> in the following ways: (Select all that apply)

a. the learning environment and climate are positive
b. there is appropriate technology, computer labs, specialized technology related to each discipline
c. there are good labs, lab equipment,
d. there is adequate student work space for assignments, projects, group meetings, etc.
e. administrators are approachable and helpful, e.g. the department chairs (heads) and dean
f. faculty are available, approachable, professional, and helpful
g. department and college staff are available, professional, and helpful in solving problems or meeting student needs, and friendly
h. faculty take extra time, or go the extra mile, and are available to support and assist students in solving problems or meeting their needs
i the academic advising I have received is of high quality and accurate
j. graduate teaching or lab assistants seem to be knowledgeable and competent

129. The <u>learning environment</u> in the college and department <u>needs to improve</u> the following: (Select all that apply)

a. the learning environment and climate
b. technology, computer labs, specialized technology related to each discipline
c. labs and lab equipment,
d. student work space for assignments, projects, group meetings, etc.
e. administrators approachability and willingness to be helpful(e. g., the department chairs (heads) and dean)
f. faculty availability, approachability, professionalism, and willingness to be helpful
g. department and college staff are availability, professionalism, and helpfulness in solving problems or meeting student needs, and friendliness
h. faculty willingness to take extra time, or go the extra mile, and be available to support and assist students in solving problems or meeting their needs
i academic advising
j. knowledge and competence of graduate teaching or lab assistants

130. Generally, when considering <u>course quality</u>, the courses I've taken so far seem to have had well planned content, sound academic purpose, appropriate and well designed lab activities, and excellent execution of student learning activities by the professor and/or grad assistant. (Select one)

a. strongly agree
b. most or many do
c. some (less than half) do
d. most or many do not

131. The courses that I've taken so far seem to have been well-structured and organized with clear learning objectives that are focused, purposeful; the courses have had well designed and developed syllabi that clearly explain the expectations of the professor for the course and a schedule or timeline provides an understanding of the events, due dates, and activities for the semester. (Select one)

a. strongly agree
b. most or many do
c. some (less than half) do
d. most or many do not

For Items 132-136, consider the <u>connections</u> between course <u>syllabi, assignments, and schedule</u> for all the courses you taken to date; when generalizing across ALL the courses you have taken in engineering or technology, <u>most</u> of your professors: (Select one response for each 132-134)

132. covered the course content specified in the syllabus, expanding when appropriate

a. yes
b. no

133. adhered to the assignments specified in the syllabus and didn't add anything significant

a. yes
b. no

134. progressed through the course according to the schedule plan in the syllabus

a. yes
b. no

135. In most of my courses, the <u>tests</u> (or other methods of measuring student learning such as projects, etc., papers, research, etc.) are <u>directly linked</u> and <u>connected to the content described in the syllabus.</u> (Select one)

a. Yes, most of the time
b. Usually, but there are some major deviations from the syllabi across courses
c. Less than half of the time; there is a lot of content on tests, or content that we are required to know and use for projects, etc. that was not specified on course syllabi
d. There has often been a "dis-connect" between the knowledge and/or skills that we were tested on or required to use on projects, etc. and what was specified on course syllabi across the courses I have taken

136. In most of my courses, the <u>tests</u> (or other methods of measuring student learning such as projects, etc., papers, research, etc.) are <u>directly linked</u> and <u>connected to the content covered by the professors.</u> (Select one)

a. Yes, most of the time
b. Usually, but there have been some major deviations by the professors across courses
c. Less than half of the time; there is a lot of content on tests, or content that we were required to know and use for projects, etc. that was <u>not</u> specified on course syllabi or <u>covered by the professors</u> or assistants.
d. There has often been a <u>"dis-connect"</u> between the knowledge and/or skills that we were tested on or required to use on projects, etc. and what was covered by the professors or assistants. A lot of course content <u>was not</u> covered by the professors or assistants.

PROFESSORS -- *<u>READ OUT LOUD CAREFULLY</u> to students before handing out questionnaires.*

To: Participating students
Fr: Dean
Re:
New initiative to study the quality of instruction, course content, and the learning environment across the college

The following questionnaire is being administered to selected classes across the college and its four departments. As students in those classes, you are being asked to participate in providing baseline information about the quality of instruction, course content, and the learning environment in the college. It is important to take note of the following:

(a) The first part of the questionnaire relates <u>only</u> to <u>this course</u>.

(b) The second part of the questionnaire relates to your experience <u>across all</u> the courses you have taken in your <u>major</u> department.

(c) <u>This questionnaire **does not seek** information about your experience in any courses outside the major department (e.g. general education or courses transferred to NIU).</u>

Your responses to these questions will be used as baseline information to study how to strengthen the quality of education across the college.

We are hoping that you will complete this questionnaire **thoughtfully, seriously, and genuinely,** with the understanding that **it is important** and **will assist us** in structuring a college initiative to study and strengthen the quality of instruction, course content, and the learning environment across the college.

In testing the questionnaire with students, it took about 20 minutes; therefore, we are allowing 30 minutes of class time to complete the questionnaire in class.

The questionnaire is somewhat long, but not as long as it may seem because the questions have been written in a way that hopefully describe thoroughly what we are seeking information about. Also the print is regular sized, and we have spaced and printed the document for easier reading.

Please attend to each item carefully and respond to the best of your ability. We need your input. It is important that you respond honestly, genuinely, and with sincerity as the results of the survey will greatly impact the Dean's new initiative on the quality of education for students in the college.

Thank you for investing your time and serious effort to help us begin this very important initiative.

End of Course Questionnaire on Teaching and Learning

Jule Dee Scarborough, 2006

After completing the student and course information on the front side of the scan form, respond to the following questions on the back side of the form beginning with item 101.

Questions 101-124 focus on the course you are now ending. Please respond to 101-124 based upon your experience in this course only.

101. The course syllabus identified specific learning objectives.

2 a. Yes, and I understood them
1 b. Yes, but I didn't understand them
0 c. I don't know
0 d. No, there were no learning objectives
Max Points Possible = 2.

102. The learning objectives for this course were chosen or required by: (Select all that apply.)

1 a. Future employers
0 b. Department head
0 c. Professor's interests
1 d. Accreditation agency
1 e. NIU General Education Goals
0 f. I don't know
Max Points Possible = 3

103. The course syllabus specified: (Select all that apply)

1 a. course or student learning objectives
1 b. course description
1 c. clearly defined course content
1 d. clearly defined assignments, labs, papers, projects, tests, or other important assignments or activities
1 e. the course schedule or timeline identifying meeting dates, assignment due dates, and the semester's schedule
1 f. additional explanations of course requirements that established the criteria for each assignment
1 g. references other than the text, e.g. books, websites, articles, other sources related to course content
1 h. contact information for professor, instructor, and/or graduate teaching or lab assistants
Max Points Possible = 8

104. The professor (and any assistants): (Select all that apply)

1 a. focused content and learning activities on the course or student learning objectives throughout the semester
1 b. provided learning that seemed to align with the course description
1 c. taught the course content specified in the syllabus
1 d. followed the assignments, labs, papers, projects, tests, or other important assignments or activities outlined and defined in the syllabus
1 e. followed the course schedule or timeline specified in the syllabus (e.g., meeting dates, assignment due dates, and the semester's schedule)
1 f. graded assignments according to the written explanations for course requirements establishing the criteria for each assignment
1 g. was(were) available, using the contact information for professor, instructor, and/or graduate assistants
1 h. deviated from the syllabus by adding appropriate content to expand, deepen understanding, or resolve questions resulting in adding value to the course; any additional assignments were appropriate having reasonable timelines
-1 i. deviated from the syllabus inappropriately where additions to the information provided on the syllabus, or new assignments added, were irrelevant or distracting and added little or no value to the course or learning; new assignments were untimely and caused unnecessary stress for students
1 j. The course was well organized, structured, and executed.
Max Points Possible = 8

105. Which of the following methods were used by the professor to measure learning? (Select all that apply)

1 a. final exam - traditional test
1 b. midterm exam - traditional test
1 c. quizzes and/or short tests periodically-traditional test(s) (e.g., multiple-choice or true/false)
1 d. quizzes and/or short tests periodically - short answer and/or essay
1 e. research or learning paper (s), usually requiring literature search or field research and formal write-up
1 f. case study(ies) in industry, usually requiring a report or short paper write-up
1 g. hands-on technical project(s)
1 h. hands-on non-technical project(s)
1 i. other types of performances, "doing" something
1 j. course portfolio, full documentation of all work and progress in the course
k. other; write a description here:

Max Points Possible = 10

106. Select ALL the descriptions below that identify the methods being used in this course to measure student learning:

1 a. Learning was measured on my ability to memorize terminology, symbols, facts, information, theory, principles, concepts, information, definitions, descriptions

2 b. Learning was measured on my ability to make comparisons to determine similar and dissimilar examples, understanding relationships and connections between and among facts, concepts, theories, principles, translates knowledge into a new context, interpret facts, predict consequences, order, group information, contrast, distinguish, estimate, differentiate, discuss, or extend knowledge

3 c. Learning was measured on my ability to use information, methods, concepts, theories in new situations; problem solving - this requires choosing and applying knowledge (e.g., the best formula, concept, principle, theory to solve problems), using inductive reasoning to determine the best methods, techniques, tools, strategies to apply towards a best solution; this method of measurement can range from a test item with a complex problem to be solved or a hands-on technical problem requiring the design and building of something mechanical. The key to this method is that it requires application of knowledge – "doing" (demonstrate, calculate, illustrate, show, solve, examine, modify, relate, change, experiment, discover).

4 d. Learning was measured on my ability to recognize patterns in information, problems, and situations; the ability to organize parts, identify or discover "hidden" meanings, and/or identify components; this requires one to analyze, separate thoughts, processes, problems, order, explain, connect, classify, and divide, compare, select, explain, and/or make inferences (indirect meanings); this requires deductive reasoning where one begins with facts and information, makes choices to gradually discover the bigger picture

5 e. Learning measured my ability to hypothesize, design, support argument, schematize, write, report, justify, choose, evaluate, estimate, judge, criticize, defend, use old ideas to create new ones, extending the old idea into a new one for extended applications, make choices based upon reasoned argument, verify value of evidence, recognize when subjectivity is being used rather than objectivity (more scientific), make sound generalizations from given facts, relate and use knowledge across different contexts, predict and draw conclusions, combine, integrate, modify, rearrange, substitute knowledge, plan, formulate, compare and discriminate between, summarize, and make conclusions

6 f. Learning measured my ability to design, discover, invent, develop, create, research; transform knowledge into a product, process, technique, model, method, strategy, etc.

Points for only highest level response only. Max Points Possible = 6

107. Select the response that best describes the relationship between the traditional tests you have taken to date in this course (e.g. multiple-choice, true/false items, etc.) and the course content .

3 a. the content of the test(s) **was related** to the content specified in the syllabus, and only to content specified in the syllabus.

2 b. the content of the test(s) **was related** to the content specified in the syllabus **and** other content provided by the professor or assistants.

1 c. the content of the test(s) **did not relate** to the content specified in the syllabus **but did relate** the other content provided by the professor or assistants.

0 d. the content of the test(s) **related to neither** (1) the content specified in the syllabus, **nor** (2) the other content provided by the professor or assistants.

Max Points Possible = 3

Items 108-111 relate to the measurement of student learning through performance(s) rather than traditional tests.

***** Consider the definitions below when responding to items 108-111.**

***** Definitions:**

*****Performance Task (or assessment) -** *any authentic or real-world task designed to measure student learning. Such a task can be used to determine what students can "do" with knowledge. Unlike some traditional tests, performance tasks require students to move to another level of providing evidence of learning - that of applying or using knowledge by performing authentic tasks, such as designing a part or product, or designing and then producing the part or product. Writing a paper would provide evidence of research skills and communication skills, for example.*

(108) Performance tasks were used to measure student learning in this course. (*see definition above)

1 a. Yes (according to the definition above)
0 b. No (according to the definition above)

Max Points Possible = 1

*****Rubric -** *any type of information sheet or form, check off sheet that establishes the levels of performance criteria for performance tasks; these criteria establish standards for performance and the criteria for each standard. They are used to provide students information about what is required to achieve a particular number of points or grade.* ***See attached example at end of questionnaire following this page; then continue to complete the questionnaire..***

(109) Rubrics were used for scoring or grading the performances in this course.

1 a. Yes (according to the definition below)
0 b. No (according to the definition below)

Max Points Possible = 1

(110) Below are examples of some performance tasks; identify any that are similar to performances that you had to accomplish during this course. Select all that apply:

1 a. Writing a paper
1 b. Working problems, showing the entire equation worked out manually, through each step of the equation
1 c. Designing a product part, entire machine, other major design project
1 d. Designing an industrial production system
1 e. Designing electrical circuitry or full electrical/electronic system
1 f. Designing and producing a part using manufacturing processes, e.g. actually producing product using manufacturing production equipment in a lab or on-site in industry

Max Points Possible = 6

(111) Select all examples of performance tasks below (similar) where a rubric or performance criteria form was used to score or grade the performance(s) during this course.

1 a. Writing a paper
1 b. Working problems, showing the entire equation worked out manually, through each step of the equation
1 c. Designing a product part, entire machine, other major design project
1 d. Designing an industrial production system
1 e. Designing electrical circuitry or full electrical/electronic system
1 f. Designing and producing a part using manufacturing processes, e.g. actually producing product using manufacturing production equipment in a lab or on-site in industry
Max Points Possible = 6

112. The following items related to levels of learning and how learning takes place. (Select ALL that apply)

1 a. the learning of basic knowledge requiring me to list, name, identify, show, define, recognize, recall, state, visualize, state facts, concepts, theories, principles, and/or information?

2 b. the comprehension or greater understanding of knowledge through activities that required me to summarize, explain, interpret, describe, compare, paraphrase, differentiate , demonstrate, classify, or contrast facts, information, concepts, theories, principles?

3 c. the application or opportunity to “do” or “perform,” using knowledge, requiring me to solve problems, illustrate, calculate, use, interpret, relate, manipulate, apply, modify facts, concepts, theories, information, or data?

4 d. analytical activities that required me to analyze and organize facts, data, and information; deduce patterns, and trends; contrast, compare, distinguish, differences or similarities; and then discuss solutions, directions and plan or devise actions?

5 e. the synthesis and evaluation of facts, information, data, situations, problems, and furthermore require me to argue rationally, support or justify a method, solution, action, choice of formula, theory, concept, principle or result in the need to propose a hypothesis, following with the design of an experiment, product, process, technique, and/or make judgments that had to be critiqued and defended and finalized into reports, summaries, or papers.

6 f. the design, discovery, invention, development, creation, research, or transformation of knowledge into products, processes, techniques, models, methods, strategies, etc., using design and development, research, experimentation, and/or development knowledge, techniques, procedures, and tools?
Points for highest level only. Max Points Possible = 6

113. This course engaged me in (Select one response)
0 a. learning knowledge and skills to use when I get a job.
1 b. learning knowledge and skills to use when I get a job, but also provided the opportunity to apply that knowledge in class through projects or activities where performing tasks using that knowledge were required
0 c. neither (a) nor (b), very well
Max Points Possible = 1

114. The following list identifies and briefly describes teaching methods the professor may use during instruction. (Select all that apply)

1 a. the professor lectures information and connections; I listen and take notes, if I choose

1 b. the professor focuses or presents content, then breaks the class into student groups to discuss the content, then engages in summarizing and clarifying the content as a group.

1 c. the professor focuses or presents content, then assigns individual but short term projects using the content or information, e.g. problem to solve, design project, analysis.

1 d. the professor focuses or presents content, breaks the class into student groups to discuss the content, and then engages in a short term group project using the content or information (e.g., problems to solve, design project, analysis)

1 e. lessons are broken down in components; as individual students master each component, they are tested. When they pass the test, they go on to the next component.

1 f. the professor uses visual charts, displays, a wide range of graphic organizers or other visuals to better organize and present information; to show relationships between concepts and principles; and to increase understanding about the application of foundation concepts or principles.

1 g. when presenting content, the professor uses examples that are and are not representative of the concept or principle. Students compare the examples and match those that represent the concept or not; gradually as more examples that are and are not representative are reviewed, the group reaches consensus of what examples directly represent the content and come away with greater understanding.

1 h. lessons require that we combine concepts and analyze the relationships of concepts; we then engage in solving problems.

1 i. during the lessons, the professor asks us to identify and enumerate information related to concepts as they are demonstrated, grouping concepts into categories with common attributes.

1 j. we learn information on concepts through the act of classification, gathering and classifying information to build and test hypotheses; they engage in experiments and the results of experiments are used to develop hypothesis generalizations about the situation, idea, or problem.

Max Points Possible = 10

115. The following list identifies and briefly describes <u>additional</u> teaching methods the professor may use during instruction. (Select all that apply)

1 a. students are presented with generalizations and examples and engage in trying to identify the individual situation or idea that is embedded (move from problem to why something happens)

1 b. students are presented with a problem and then create questions to be used to solve the problem. Students engage in a process of investigation and explanation of the phenomena.

1 c. students engage in a formally organized court case to present information and arguments about the ingrained issues.

1 d. students are instructed on each component of the content, and all must be successful on that content before the professor moves on with new or more complex content

1 e. lessons break skills down into components and sequences of action; each person learns the skill step by step the same way

1 f. lessons begin by focusing on a current situation; analogies are used to define the characteristics of the situation; analogies continue, using other graduated analogies until it appears to have no relationship to the origin; the lesson then uses the final description of the analogy to compare to the original situation

1 g. lessons engage us in the development of physical skills, such as welding

1 h. the professor uses metaphors to make content more familiar

1 i. lessons focus on personal development, free expression of ideas and feelings, furthering your self-understanding

1 j. students explore problems through actions developing problem solving skills; we participate and/or observe

Max Points Possible = 10

116. My professor exhibited the following styles of instruction throughout the semester. (Select all that apply.)

1 a. professor makes all decisions on what, where, when, and how learning takes place; is the expert; strives for precision, synchronization, and uniformity; determines what is taught and how it will be evaluated

1 b. students are given a number of tasks to do while in class; students can ask questions; professor moves around and gives feedback

1 c. students provide feedback to each other; one student performs while another provides feedback; professor designs forms to guide the observations; socialization is inherent in this style; students develop feedback skills

1 d. feedback is provided by you as the individual learner to yourself; other events providing external feedback facilitate your ability to do this; professor helps you become a better evaluator, thus, increasing your self-esteem about working independently

1 e. we select our own level of performance and alter it according to my/our self-evaluation; the professor determined the tasks and defined the levels of difficulty

1 f. professor leads students to discover concept by answering a series of questions; professor determines concepts and best sequences for guidance; friendly environment with time to think built into the learning opportunity; professor traces a series of questions leading to the answer

1 g. professor presents question; students use logical and critical thinking to discover solutions; students determine questions to ask rather than the professor; professor respects the student process and dos not interfere

1 h. professor encourages students to find multiple solutions to given problems; professor selects the subject and designs the problem; there is no one right answer; professor responds to student process rather than the value of a solution or answer

1 i. the student and professor select the content to be learned; the student designs, develops, and performs the series of tasks **and/or** students select the activity, design the experiences, perform the tasks; professors assists/consults with the evaluation of tasks

1 j. students are empowered to take full responsibility for the learning process; they are not required to consult with the professor

Max Points Possible = 10

117. Which of the following best describes this course?
Choose the one item that comes closest to describing your experience in this course.

0 a. The professor assumes the entire responsibility for delivering the course content. He/she lectures all information we are expected to learn. The text is used as a reference. Lectures reflect text content.

0 b. The professor assumes the entire responsibility for delivering the course content in combination with assigned readings from the textbook. The lectures and text content provide all the information we are expected to learn. Most lectures correlate directly or are duplication of text content.

0 c. Students are assigned reading from the text to gain basic course content. My professor explains difficult content from the text and then adds lectures on some important or critical content that is not covered in the text, thus expanding or deepening understanding and ability to use the information from the text.

1 d. Students are responsible for some of their own learning. For example, once a concept or principle is explained by the professor and we have used the text for basic learning, as a source or reference, we then have to perform research on content ourselves to deepen our understanding of the concept and its application possibilities. We have to bring the information back to class to share with the professor and class. Student activities can vary from literature research, case studies, identifying additional sources of information, e.g. books, people, examples, demonstrations, etc. Students are required to learn on their own or in small groups to deepen understanding or extend learning and understanding beyond that presented by the professor or established learning activities.

2 e. The professor assigns reading from the text, explains difficult content, and then provides content to deepen or extend the basic text content or to clarify or explain content not well understood. Students are responsible for some of their own learning, and we then engage in research to solidify our understanding of the content. Ultimately, the professor then assigns projects that expand learning into the "doing" dimension where we used the content learned to solve a problem, develop a product, construct a theoretical model, use materials, processes, and knowledge to create, etc.

3 f. Students are responsible for a great deal of their own learning. After working with us in a variety of ways, many of them are highly engaging students to learn important knowledge and skills where the professor is more of a learning coach, direction setter, source of validation, someone who models an inquiry driven process of learning, with a strong focus on "how" and "why" processes. He/she provides the opportunity to engage in the creation of a solution to an identified need or problem, applying the knowledge and skills learned earlier or throughout the learning processes throughout the semester.

Max Points Possible = 3

118. This course provided the opportunity to work cooperatively in small groups to accomplish the learning of course content. (Select one)

1 a. Yes
0 b. No
Max Points Possible = 1

119. When working together, we sought outcomes that benefited me individually as well as the whole group. (Select one)

2 a. Most of the time
1 b. Some of the time
0 c. Not really
0 c. No opportunity to work in groups
Max Points Possible = 2

120. When working with others, I feel that we maximized my own learning and the learning of others. (Select one)

2 a. Most of the time
1 b. Some of the time
0 c. Not really
0 d. No opportunity to work in groups
Max Points Possible = 2

121. Working in groups provided greater opportunity for everyone to learn more and resulted in higher grades for all. (Select one)

2 a. Most of the time
1 b. Some of the time
0 c. Not really
0 d. No opportunity to work in groups
Max Points Possible = 2

122. When you were required to work in student groups throughout the course, were those group assignments formally organized with criteria for performance? (Select one)

2 a. Most of the time
1 b. Some of the time
0 c. Not really
0 d. No opportunity to work in groups
Max Points Possible = 2

123. When you were required to work in student groups throughout the course, did the professor provide formal and specific team related instruction on how to function effectively and productively on a team? (Select one)

1 a. Yes
0 b. No
Max Points Possible = 1

124. Working in groups results in:
(Select as many as apply b-i; if you choose response a, move on to question 125)

0 a. there was no opportunity to work in groups
(**if you choose this selection, move on to question 125**)

1 b. higher achievement and productivity by all or almost all members of the group

1 c. longer term retention of knowledge being learned

1 d. intrinsic (inside myself) and higher motivation to achieve by all or almost all members of the group; greater focus and time on task

1 e. higher level thinking, reasoning, deeper analysis of problems, better judgments

1 f. more positive relationships between most students or among group members and more caring about each other's learning and success; feelings of more support in learning

1 g. greater value of diversity among group members; greater cohesion among students in the course

1 h. the development of higher self-esteem among most students; further development of self identify

1 i. development of social skills so that students learn to engage with each other in a positive manner, even when conflicting ideas are on the table

1 j. greater ability to cope with adversity and stress
Max Points Possible = 9

125. The professor's language skills <u>were not</u> a barrier in communication between the professor and students.

4 a. <u>Strongly agree</u> - the professor's language skills were <u>exceptionally good</u>; very effective communication took place between the professor and students.

3 b. <u>Agree</u> - the professor's language skills were <u>good</u>; there was effective communication between the professor and students.

1 c. <u>Disagree</u> - the professor's language skills <u>need to improve</u> for effective communication to occur between the professor and students.

0 d. <u>Strongly Disagree</u> - the professor's language skills were <u>inadequate</u> for effective communication between the professor and students; poor language skills resulted in communication barrier between the professor and students.
Max Points Possible = 4

Unlike Items 101-125 above which focused on THE course you are NOW in and completing, <u>the following questions are focused more broadly</u>.

<u>For Items 126-136, reflect on your experience across ALL the courses</u> you have taken in engineering and/or technology to date. Provide your perspective by <u>generalizing across ALL the courses</u> that you have taken in engineering and/or technology to date and respond to Items 125-135 below.

126. The <u>professors</u> teaching the engineering and/or technology courses that I've taken to date in my major: (Select one)

3 a. seem exceptionally competent and knowledgeable
2 b. seem competent and knowledgeable
1 c. seem adequate in their knowledge
0 d. professor's knowledge seems questionable
Max Points Possible = 3

127. The professors <u>teaching</u> the courses that I've taken in engineering and/or technology teach in a way that: (Select one)

2 a. motivates me to want to learn and perform in those classes at a very high level; they keep me interested, excited, and make me realize that I have chosen the right field or career track for me

1 b. keeps me interested most of the time so that I perform above average most of the time

0 c. is difficult for me to maintain my interest in the courses; it is often difficult to remain interested all the way through each class; I feel I can read the book and take the tests and still perform well enough for an adequate grade

0 d. truly causes me to be less motivated to perform, making it almost impossible to remain interested in the courses or content being covered
Max Points Possible = 2

128. The <u>learning environment</u> in the college and department <u>is positive</u> in the following ways: (Select all that apply)

1 a. the learning environment and climate are positive
1 b. there is appropriate technology, computer labs, specialized technology related to each discipline
1 c. there are good labs, lab equipment,
1 d. there is adequate student work space for assignments, projects, group meetings, etc.
1 e. administrators are approachable and helpful (e.g., the department chairs (heads) and dean)
1 f. faculty are available, approachable, professional, and helpful
1 g. department and college staff are available, professional, and helpful in solving problems or meeting student needs, and friendly
1 h. faculty take extra time, or go the extra mile, and are available to support and assist students in solving problems or meeting their needs
1 i the academic advising I have received is of high quality and accurate
1 j. graduate teaching or lab assistants seem to be knowledgeable and competent
Max Points Possible = 10

129. The <u>learning environment</u> in the college and department <u>needs to improve</u> the following: (Select all that apply)

-1 a. the learning environment and climate
-1 b. technology, computer labs, specialized technology related to each discipline
-1 c. labs and lab equipment,
-1 d. student work space for assignments, projects, group meetings, etc.
-1 e. administrators approachability and willingness to be helpful (e.g., the department chairs (heads) and dean)
-1 f. faculty availability, approachability, professionalism, and willingness to be helpful
-1 g. department and college staff are availability, professionalism, and helpfulness in solving problems or meeting student needs, and friendliness
-1 h. faculty willingness to take extra time, or go the extra mile, and be available to support and assist students in solving problems or meeting their needs
-1 i academic advising
-1 j. knowledge and competence of graduate teaching or lab assistants
Max Points Possible = 0

130. Generally, when considering <u>course quality</u>, the courses I've taken so far seem to have had well planned content, sound academic purpose, appropriate and well designed lab activities, and excellent execution of student learning activities by the professor and/or grad assistant. (Select one)

3 a. strongly agree
2 b. most or many do
1 c. some (less than half) do
0 d. most or many do not
Max Points Possible = 3

131. The courses that I've taken so far seem to have been well-structured and organized with clear learning objectives that are focused, purposeful; the courses have had well designed and developed syllabi that clearly explain the expectations of the professor for the course and a schedule or timeline provides an understanding of the events, due dates, and activities for the semester. (Select one)

3 a. strongly agree
2 b. most or many do
1 c. some (less than half) do
0 d. most or many do not
Max Points Possible = 3

For Items 132-136, consider the <u>connections</u> between course <u>syllabi, assignments, and schedule</u> for all the courses you taken to date; when generalizing across ALL the courses you have taken in engineering or technology, <u>most</u> of your professors:

(Select one response for each 132-134)

132. covered the course content specified in the syllabus, expanding when appropriate

1 a. yes
0 b. no
Max Points Possible = 1

133. adhered to the assignments specified in the syllabus and didn't add anything significant

1 a. yes
0 b. no
Max Points Possible =1

134. progressed through the course according to the schedule plan in the syllabus

1 a. yes
0 b. no
Max Points Possible = 1

135. In most of my courses, the <u>tests</u> (or other methods of measuring student learning such as projects, etc., papers, research, etc.) are <u>directly linked</u> and <u>connected to the content described in the syllabus.</u> (Select one)

2 a. Yes, most of the time
1 b. Usually, but there are some major deviations from the syllabi across courses
0 c. Less than half of the time; there is a lot of content on tests, or content that we are required to know and use for projects, etc. that was not specified on course syllabi
-1 d. There has often been a "dis-connect" between the knowledge and/or skills that we were tested on or required to use on projects, etc. and what was specified on course syllabi across the courses I have taken
Max Points Possible = 2

136. In most of my courses, the <u>tests</u> (or other methods of measuring student learning such as projects, etc., papers, research, etc.) are <u>directly linked</u> and <u>connected to the content covered by the professors.</u> (Select one)

2 a. Yes, most of the time
1 b. Usually, but there have been some major deviations by the professors across courses
0 c. Less than half of the time; there is a lot of content on tests or content that we were required to know and use for projects, etc. that was <u>not</u> specified on course syllabi or <u>covered by the professors</u> or assistants.
-1 d. There has often been a <u>"dis-connect"</u> between the knowledge and/or skills that we were tested on or required to use on projects, etc. and what was covered by the professors or assistants. A lot of course content <u>was not</u> covered by the professors or assistants.
Max Points Possible = 2

Assessment - Orientation

1. Describe the "national call for action" regarding teaching.

2. Identify and describe the four types of research defined by Ernest Boyer (1990).

3. Describe the "reversed" instructional design process - simply describe. Where are we in the "reverse" process?

4. Describe a learning community. What are learning circles?

5. What are its primary characteristics?

6. What are communities of practice?

7. Identify the components of Deming's quality improvement cycle. Where are we in that cycle?

8. Describe Senge's meaning of "learning" for individuals and/or organizations. What would you consider to be important aspects of his definition of learning?

9. Describe your "duty" as a professor.

10. What are your responsibilities as a professional who teaches?

11. What emphases are important for teaching professionals?

12. What is your product?

13. Who is your customer? External- Internal-

14. What was different about the definition of knowledge presented during Orientation than what most would expect to it to be?

15. Learning requires some major shifts, as described by Senge. What are they; most importantly, what do they reveal?

16. How is learning constructed?

17. Where does knowledge reside?

18. Generative, in the context we are in, and as described by Senge, means….

19. How is "creative tension" important?

20. Describe "transformative learning" and "transformative pedagogy". What result does transformative pedagogy have that other pedagogies do not?

21. What meaning does Dale's Cone have for you?

22. What meaning does Bloom's Taxonomy have for you?

23. What is the difference between the traditional Bloom and the Revised Bloom's Taxonomy?

Assessment - Course Analysis

1. List and describe all "teaching styles" you know about or use.

2. List and describe all student "learning styles" you know about or use.

3. List and describe all "teaching models" you know about or use.

4. Describe an example of "active" learning.

5. Describe an example of "passive" learning.

6. Describe what "critical thinking" means to you in the context of education in higher education and your role in higher education.

7. Describe what "teacher," "knowledge," "assessment," and "learner" centered means in the context of higher education.

8. What does "student learning objective" mean? Provide an example.

9. What does "student learning outcome" mean? Provide an example.

10. How are ABET or ABET TAC/NAIT standards to be used?

11. Describe "stages of learning."

12. What meaning does “centered” have in our context?

Assessment - Student Learning Objectives

1. Define the following types of student learning statements:

a. Objective

b. Outcome

c. Behavioral Objective – how does this one differ from the others?

d. Goal

e. Standard

2. List a-e above in priority of specificity, broadest statement to most specific statement.

3. Describe each type of objective on the continuum of objectives, global → educational → instructional. What purpose does each one serve? Describe the nesting priority, i.e. which ones are nested within the other(s)?

4. Are objectives the "means to the end" or the "end"? Why?

5. When planning student learning, what model is accepted as the best practice?

6. What is essential in verb choice for learning statements?

7. Discuss the difference between "subject matter content" and "knowledge."

8. Describe the difference between "content" standards and "performance" standards.

9. What does "KSA" stand for?

10. Describe "mastery learning targets."

11. What are "developmental learning targets"?

12. How can Bloom's Revised Taxonomy of Learning be used in course planning?

Test Analysis **Name:_______________________________________**

1. In the context of item analysis, what is meant by the term *item difficulty*?

2. In the context of item analysis, what is meant by the term *item discrimination*?

For items 3 & 4 choose the BEST answer.

3. An item in a test is worth 3 points. Ten students obtained the full 3 points, seven obtained 2 points, six obtained 1 point, and two students obtained zero points. What is the *item difficulty* for this item?
   A. The item would be considered *very easy* because only two students received no credit for the item.
   B. The item would be considered *moderately difficult* because nine students (36%) received either two points or one point for the item.
   C. The item would be considered *very difficult* because only ten students (40%) received full credit for the item.
   D. About .40
   E. About .67
   F. Can't tell with the information provided.

4. What is the *item discrimination* for the item presented in question 3 above?
   A. The item would be judged a *highly discriminating* item because ten students obtained full credit for the item and two received no credit for the item.
   B. The item would be considered a *moderately discriminating* item because the students scores' on the item are reasonably distributed (spread out).
   C. The item would be considered a *poorly discriminating* item because a large percentage of the students (about 68%) received 2 or 3 points for the item.
   D. About .40
   E. About .67
   F. Can't tell with the information provided.

For items 5 through 10 indicate either True or False.

5. If an item is very difficult, it will have poor item discrimination.

6. A highly discriminating item will be of moderate difficulty (neither very difficult nor very easy).

7. A very low level of discrimination for an item indicates that the item probably didn't work very well on the exam and that the item should be considered for modification.

8. If all students answer an item correctly (all students obtain full credit for the item), then the item is too easy and, therefore, should not be included in the exam because it doesn't contribute to the variation of students' scores.

More items on back.

9. If, as a result of item analysis, an item is judged to be extremely difficult, then either the instructor did a poor job teaching or the students did a poor job learning.

10. For a given exam, the sum of students' scores on the exam is mathematically equal to the sum of items' scores on the exam.

Test Analysis **Name:______________________________________**

1. In the context of item analysis, what is meant by the term *item difficulty*?

   The proportion of points awarded from an item to the number of points that could be awarded from the item.

2. In the context of item analysis, what is meant by the term *item discrimination*?

   The correlation, across students, between item scores and total test scores.

For items 3 & 4 choose the BEST answer.

3. An item in a test is worth 3 points. Ten students obtained the full 3 points, seven obtained 2 points, six obtained 1 point, and two students obtained zero points. What is the *item difficulty* for this item?
   A. The item would be considered *very easy* because only two students received no credit for the item.
   B. The item would be considered *moderately difficult* because nine students (36%) received either two points or one point for the item.
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   D. About .40
   E. About .67
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4. What is the *item discrimination* for the item presented in question 3 above?
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   C. The item would be considered a *poorly discriminating* item because a large percentage of the students (about 68%) received 2 or 3 points for the item.
   D. About .40
   E. About .67
   F. Can't tell with the information provided.

For items 5 through 10 indicate either True or False.

5. If an item is very difficult, it will have poor item discrimination.

   False

6. A highly discriminating item will be of moderate difficulty (neither very difficult nor very easy).

   False

More items on back.

7. A very low level of discrimination for an item indicates that the item probably didn't work very well on the exam and that the item should be considered for modification.

True

8. If all students answer an item correctly (all students obtain full credit for the item), then the item is too easy, and, therefore, should not be included in the exam because it doesn't contribute to the variation of students' scores.

False

9. If, as a result of item analysis, an item is judged to be extremely difficult, then either the instructor did a poor job teaching or the students did a poor job learning.

False

10. For a given exam, the sum of students' scores on the exam is mathematically equal to the sum of items' scores on the exam.

True

Test Rubric (Scarborough, 2006)

Test Characteristics	Pts.	Adequate Quality Level – Not Acceptable (our project)	Pts	Model of Excellence – Required Quality Level (our project)
Table of Specifications	1	Many content areas are covered; some important areas are not Knowledge is the primary level covered in the test. Many items are directly linked to Learning Outcomes(Objectives) -Master Targets, but not for entire course – Primary and highly prioritized areas covered Test includes only **THREE** item types	2	All or almost all of the content areas are sampled - are covered by test items Test should include knowledge, comprehension, and application levels Items are linked directly to Learning Outcomes (Objectives.)-Master Targets for entire course Test should include **multiple** item types, **5 types (for our project)**
Overall Appearance	1	Test may have a few inconsistencies in layout and appearance; it may require some, but not major, modification; grammar, wording, organization is appropriate and professional	2	Test should be professionally laid out, with consistent formatting and a generally pleasing appearance; good grammar, wording, organization
Overall Instructions for the Exam	1	Instructions are not direct, include few ambiguities, are too long, or require students to assume what they are supposed to do, how they are supposed to answer.	2	Instructions should be direct, clear, unambiguous, concise, and easy to follow
Instructions for Specific Subsets of Items	1	Instructions are not direct, include few ambiguities, are too long, or require students to assume what to do and how to answer.	2	Instructions should be direct, clear, unambiguous, concise, with appropriate reading level, and easy to follow
Item Quality	1	A few, but not many, items are less well written, ambiguous, and/or do not conform to item writing guidelines.	2	Clear, direct, well-written, with no clues. They basically conform to item writing guidelines.
Fair for a diverse range of learners	1	Many examinees finish early, or a few, but not many, examinees don't finish in the allotted time Most of the language is at an appropriate level, but some language or vocabulary may be too elementary or too difficult Regarding race, ethnicity, gender, only Excellent is acceptable	2	Appropriate time for test administration (virtually all examinees should complete the exam in the allotted time) Appropriate language/vocabulary level for course level Appropriate race, ethnic, gender, cultural references – should be race- and ethnic- cultural-gender-balanced (or neutral)
Item Difficulty	1	A few items are too easy or too difficult	2	No items are too difficult or too easy (can be confirmed with post-testing item analysis).
Item Discrimination	1	A few items have low (less than 0.10) or negative discrimination	2	No items have discriminations less than 0.10 (can be confirmed with post-testing item analysis).

PERFORMANCE TASK AND RUBRIC DEVELOPMENT ASSESSMENT
Jule Dee Scarborough, Ph.D.

The learning and professional growth on the Performance Assessment program or knowledge component was measured by the professors' performance on the task of designing and developing three complex performance tasks and three corresponding rubrics for scoring task achievement. Using the Rubrics below as guiding criteria, they each designed three complex performance tasks and corresponding rubrics. These assessments were added to their course a new assessment strategy and assessment procedures.

It is important to note that one performance task/rubric was designed to correspond with the midterm, and another to correspond with the final exam using the logic that objective tests usually reflect what students know or know about rather than what they can do. Therefore, we used an unusual scenario where the professors "linked" the objective midterm exam to a midterm performance task/rubric as well as an objective final exam to a final performance task/rubric. They also developed a third performance task/rubric and choose how and when to use it. They were asked to "match" where they thought the test items and performances "overlapped" and measured the same or similar content. It was assumed from studying the literature that performance assessment measures different aspects of learning, sometimes deeper levels of learning through use of knowledge in more active or engaging ways, problems, projects, etc. But performance assessment can also measure some of the same aspects of learning as objective tests. Also some of the professors designed their tests to incorporate some level of performance in subjective or problem based items. In examining the tests and analyzing them, the objective items were separated from the more performance based items.

Professors were provided a presentation about Performance Assessment. Performance Tasks and Rubrics were discussed, and they received a portfolio of sample tasks and rubrics. They were given books on the topic as part of their new library on teaching and learning. Their performance tasks and rubrics reflect the ABET or NAIT standards with corresponding rubrics. Perhaps one professor had used simple and less formalized rubrics before, but none of the professors had developed or used formal, written, scenario-based performance tasks with corresponding rubrics before this initiative. Thus, there were no previous instruments to view from the baseline semester, Fall 2005, and compare to these. Therefore, we judged them based upon the Rubrics below.

Performance Task: Design and develop three complex <u>performance</u> <u>tasks</u> with corresponding <u>rubrics</u>. The tasks must be based upon the ABET outcomes or NAIT standards and corresponding student learning outcomes for the course; they must also reflect real world, authentic performances, tasks, or behaviors in the appropriate community of practice, e.g. industry. The performance tasks and rubrics must be used to measure student learning in the experimental research course, Fall 2006. See the **Rubrics** below for the achievement criteria to use in accomplishing the task.

Performance: The professors accomplished the performance task well. The process involved drafting initial and authentic real world scenarios with embedded task clusters and a corresponding rubric instrument for each task (3). The program leader provided feedback one-on-one as the performance tasks were developed. The professors shared their drafts with each other and benefited from the group critique process. The group process worked especially well. The tasks and rubrics were finalized; the program leader approved them; and then, each professor used the tasks and corresponding rubrics successfully with students during the 2006 experimental research semester. After the semester was completed, the professors copied all rubrics returned to each student in their classes for all three performance tasks. The program leader reviewed the scored/with comments rubrics that each student received back from the professors. Thus, the use of the rubrics was also reviewed. Finally, the professors completed a feedback/evaluation form about the use of performance assessment for the first time. As with test analysis

and development, the feedback from the professors on the value of learning to design, develop, and use performance tasks/rubrics was extremely positive.

The following rubrics were used to guide the professors in the development of the three performance tasks and corresponding rubrics for each task.

Also, the feedback and evaluation questionnaire and professor responses are provided below, following the rubrics. The faculty members truly felt that expanding their assessments to include performance tasks with rubrics was extremely positive. They all indicated that they will continue to use performance assessment, tasks and rubrics, and also expand the use of performance assessment to other courses.

Responses to the feedback and evaluation related to Performance Assessment follows the rubrics below.

Rubric for Assessing the Quality of a Performance Task

Key Components - Properly Designed Performance Tasks must

- **I. Be based on content standards established by ABET or NAIT**
- **II. Describe a "real-life" scenario; are real world, authentic tasks; require active performances**
- **III. Involve students in complex reasoning – critical thinking at upper levels of Bloom's Cognitive Dimension**
- **IV. Require students to collect and process information, using it for an authentic purpose**
- **V. Incorporate "habits of mind"**
- **VI. Require student collaboration and cooperation; incorporates "individual" and "group" learning and performance accountability**
- **VII. Result in a tangible product and/or communication activity**

For each component, there are descriptors reflecting levels of achievement possible:

I. The Performance Task is based on the ABET or NAIT standards

a. The Performance Task is directly related to the ABET or NAIT standards.
b. Learning standards are apparent, but the relation to the task and/or national standards is sketchy or not apparent.
c. The Performance Task does not appear to be based on the standards/outcomes, course or national.

II. The Performance Task describes a "real-life" scenario that is authentic and requires active performance.

a. The scenario described in the task accurately mirrors an activity in the community of practice outside the classroom.
b. The scenario described in the task simulates an activity in the community of practice outside the classroom.
c. The scenario described in the task contains some aspects of activity outside the classroom but is largely contrived.
d. The scenario described in the task is an academic exercise that usually takes place only in the context of an academic setting.

III. The Performance Task involves students in complex reasoning-critical thinking processes at upper levels of Bloom's Cognitive Dimension.

a. The task requires students to utilize complex reasoning – critical thinking skills, such as induction/deduction, diagnosis, abstracting, experimental inquiry, problem solving; evaluation, creation, synthesis, etc.
b. The task requires students to utilize complex reasoning components, such as comparing, classifying, decision making, or investigation.
c. The task requires students only to recall facts.

IV. The Performance Task requires students to collect and process information, using it for an authentic purpose.

a. The task incorporates a variety of information gathering techniques and information resources. Students are required to interpret and synthesize information and accurately assess the value of information gathered. They are required to collect the right information for an authentic purpose, e.g. solve a problem, apply or use in a complex project, etc.
b. The task requires students to gather and synthesize information, but the value of the information gathered is not assessed. Information may not be used for a purpose.
c. The task requires the students to gather information, but not to interpret it.
d. The task requires no gathering or processing of information.

V. The Performance Task incorporates "Habits of Mind."

a. The task requires students to make effective plans, use necessary resources, evaluate effectiveness of their own actions, seek accuracy, and engage in activities when answers or solutions are not immediately apparent.
b. The task only requires students to effectively plan or use resources.
c. The task does not require students to engage in self-regulation, critical, or creative thinking.

VI. The Performance Task requires student collaboration and cooperation; incorporates "individual" and "group" learning and performance accountability.

a. The task requires students to use interpersonal skills, work toward the achievement of team goals, and perform a variety of roles within the team. There is a formal team structure and process.
b. The task requires students to work together in teams but there are no measures described that ensure collaboration or cooperation among team members.
c. The task is completed largely by students on an individual basis rather than in student teams.

VII. The Performance Task results in a tangible product and/or communication activity.

a. The task result is a tangible product or communication activity comparable to that commonly produced in business or industry community of practice.
b. The task results in a product that is similar to those completed in business or industry community of practice, but lacks several components that make the product realistic.
c. The task does not result in a product or communication activity relevant to a business or industry community of practice.

(Scarborough, 2006 [Based upon White & Scarborough, 2004])

Rubric for Assessing the Quality of a Rubric

Properly Designed Rubrics Must

- **I. Contain a set of key components/standards to be assessed that reflect the student learning outcomes for the course, which are directly linked to the national outcomes.**
- **II. Include descriptors for each component/standard that are measurable.**
- **III. Have descriptors-criteria that are indicative of observable student performances or behaviors.**
- **IV. Incorporate a clear and well-defined scoring system**
- **V. (Optional) Include appropriate weights for each component and descriptor**

For each component, there are descriptors reflecting levels of achievement possible:

I. The rubric contains a set of key components (standards) to be assessed.

a. A complete list of key components-standards is provided for the performance task, including the embedded subtasks, if a cluster. The task(s) are directly connected to student learning outcomes for course and the national outcomes.
b. Key components/standards listed are not exhaustive for the performance task and/or subtasks embedded are not clear enough for student response or action; components or standards are not clearly connected to student learning outcomes for course.
c. Not all key components/standards describe student outcomes; some are not directly linked to national outcomes.
d. No key components are listed.

II. The rubric includes a set of descriptors-criteria for each key component or standard.

a. Descriptors-criteria for each component or standard are arranged in a clear hierarchy from non-achievement to full-achievement.
b. Descriptors-criteria are present for each component/standard, but obvious levels in some are missing.
c. Each component does not have an associated set of descriptors-criteria.

III. The rubric descriptors/criteria are clear and contain observable or measurable student performances or behaviors.

a. All descriptors-criteria clearly delineate levels of observable student performances or behaviors.
b. Most descriptors-criteria clearly delineate levels of observable student performances or behaviors.
c. Only a few descriptors-criteria clearly define levels of observable student performances or behaviors.
d. Descriptors-criteria do not describe observable student performances or behaviors.

IV. **Incorporate a clear and well-defined scoring system**

a. There is a well defined and clear system for scoring each component-standard and its descriptors- criteria. Points or percentages are assigned appropriate to instructional and performance values.
b. The scoring system lacks definition, clarity, and although there is a scoring system, some aspects are ambiguous, subjective or unclear.
c. There is no scoring system.

V. Optional: Appropriate weights are assigned to components and descriptors.

a. Component-standards and descriptors-criteria are each properly weighted according to instructional emphasis and performance values.
b. Weights are assigned, but point values do not reflect proper instructional emphasis and performance values in all cases.
c. Weights are assigned to some performance standards and descriptors, but not others.

(Scarborough, 2006 [Based upon White & Scarborough, 2004])

Research Designs and Inferential Statistical Procedures

Name: ___________________________________ Date: ___________________

For items 1-6, select the letter from the lists below (A – M) that answers the question or is the best correspondence to the statement.

<u>Experimental Designs:</u>

A. Design 1. The One-Shot Case Study:			X	O
B. Design 2. The One-Group Pretest-Posttest Design:		O	X	O
C. Design 3. Static-Group Comparison:			X	O
		- - - - -	- - - - -	O
D. Design 4. Pretest-Posttest Control Group Design:	R	O	X	O
	R	O		O
E. Design 5. Solomon Four-Group Design:	R	O	X	O
	R	O		O
	R		X	O
	R			O
F. Design 6. Posttest-Only Control Group Design:	R		X	O
	R			O

<u>Threats to Internal Validity:</u>

G. History
H. Maturation
I. Testing
J. Instrumentation
K. Regression
L. Selection
M. Mortality

1. These three experimental designs are considered *pre-experimental designs*:

_______, _______, and _______.

2. These three experimental designs are considered *true experimental designs*:

_______, _______, and _______.

3. This threat to internal validity refers to events that occur between the pretest and posttest, in addition to the treatment, that could affect the posttest scores. ______.

4. This threat to internal validity refers to the test or testing process being different at posttest than it was at pretest. _____.

5. Which experimental design is the most used design and sometimes called the classical experimental design? ______.

6. This is a design that *does not* control for the effects of history and maturation. ______.
(More than one answer is possible.)

---

7. Posttest scores in an experimental design involving experimental and control groups with random assignment of subjects to groups assures that the threats to internal validity are not only controlled, but eliminated. True False

8. Retaining the null hypothesis is consistent with inferring that the treatment, X, had no effect on posttest scores. True False

9. Inferential statistical procedures allow us to conclude that either the treatment was effective or it was not. True False

10. The basic experimental inference we wish to make after we've concluded our research is that
   A. the posttest mean is higher than the pretest mean.
   B. the null hypothesis is true.
   C. the treatment , X, caused or was directly related to the observations made.
   D. the treatment, X, was one possible cause for the difference between the pretest and posttest means.

Research Designs and Inferential Statistical Procedures

Name: ______________________________ Date: ________________

For items 1-6, select the letter from the lists below (A – M) that answers the question or is the best correspondence to the statement.

Experimental Designs:

A. Design 1. The One-Shot Case Study:			X	O
B. Design 2. The One-Group Pretest-Posttest Design:		O	X	O
C. Design 3. Static-Group Comparison:			X	O
				O
D. Design 4. Pretest-Posttest Control Group Design:	R	O	X	O
	R	O		O
E. Design 5. Solomon Four-Group Design:	R	O	X	O
	R	O		O
	R		X	O
	R			O
F. Design 6. Posttest-Only Control Group Design:	R		X	O
	R			O

Threats to Internal Validity:

G. History
H. Maturation
I. Testing
J. Instrumentation
K. Regression
L. Selection
M. Mortality

1. These three experimental designs are considered *pre-experimental designs*:

__**A**__, __**B**__, and __**C**__.

2. These three experimental designs are considered *true experimental designs*:

__**D**__, __**E**__, and __**F**__.

3. This threat to internal validity refers to events that occur between the pretest and posttest, in addition to the treatment, that could affect the posttest scores. __**G**__.

4. This threat to internal validity refers to the test or testing process being different at posttest than it was at pretest. __**J**__.

5. Which experimental design is the most used design and sometimes called the classical experimental design? __**D**__.

6. This is a design that *does not* control for the effects of history and maturation. **A or B**
(More than one answer is possible.)

---

7. Posttest scores in an experimental design involving experimental and control groups with random assignment of subjects to groups assures that the threats to internal validity are not only controlled, but eliminated. True False

8. Retaining the null hypothesis is consistent with inferring that the treatment, X, had no effect on posttest scores. True False

9. Inferential statistical procedures allow us to conclude that either the treatment was effective or it was not. True False

10. The basic experimental inference we wish to make after we've concluded our research is that
   A. the posttest mean is higher than the pretest mean.
   B. the null hypothesis is true.
   C. the treatment , X, caused or was directly related to the observations made.
   D. the treatment, X, was one possible cause for the difference between the pretest and posttest means.

(COPIED FROM B.0)

PORTFOLIO SUMMARY COMMENTS

Jule Dee Scarborough, Ph.D.

(See Tables 1 and 2 below)

The Portfolio Assessment Chart below reveals that all professors except one completed all aspects of the program and research semester successfully. That means that each of those seven professors completed the faculty development program of learning with significant gain in learning. Seven professors completed all teaching and learning products during the faculty development program; and all seven professors fully participated in the research semester, executing experimental research in the classroom with their students. All seven professors prepared a research manuscript and submitted it for publication. However, one of the seven professors did not complete some activities as planned; he/she did not diagnostically analyze the final examination and did not use the second and third performance assessments as planned. That individual did complete the research as planned but did not implement the full range of changes prepared and planned for the 2006 course. This culminating assessment, college portfolio, provides evidence that the program was very successful, resulting in significant change and a new range of teaching and learning activities for each professor. The portfolio also reflects each professor's preparation for the research semester, itemizing the products developed and used during the 2006 experimental research semester. Generally, the portfolio chart reveals the results of the faculty development program and research semester and documents the professors' learning and progress toward new teaching and learning strategies, as well as that toward the Scholarship of Teaching.

Teaching Portfolio Assessment Forms and Check-Off Forms Below

Teaching Portfolio Assessment Chart Form, DATE - CITL Faculty Development Program

Portfolio Product (Artifact) Content (See Sections of information following this summary)	Faculty Member				Faculty Member		
Self Assessment Baseline: 1.____Student Questionnaires (f05 & f06) 1.____Professor completion(s) of Student Questionnaire (f05 &f06) 2.____Professor completions of Self Competency Questionnaire (Feb.06, May06, Dec.06) **3.____**Program Components Assessments (8) 4.____Standard Departmental Course Evaluations (f05 & f06) 4.____ Student Grades & End of Semester Grades (f05 & f06)							
5. Course Analysis: 5a1._Course Outline, Embedded Gen Ed, Content Priorities 5a2._Course Content Analysis by TM,TS, LS, Bl, Dale, etc. 5b. _ Instr. Design GAPS Analysis on- TM, TS, LS, B, D 5c. _ Instructional GAPS Summary 5d. _ ABET/TAC/NAIT SLO by Bloom's Analysis 5e. _ Course Content Schedule 5f._ Teaching Models+Cooperative Learning+Study Chart+TM graphic 5g._ Course Calendar by TM, TS, LS, B, D							
*****Student Learning Styles Inventory:*** (NOT REQUIRED)** Kolb (Extra professional effort on part of professors) Felder (Extra professional effort on part of professor)							
Multifaceted Assessment System: 5h.__ Multifacted Assessment Plan Graphic, showing course assessments 5i. __Test and Test Items by SLO Chart 5j.__Assessment Analysis by Bloom (Chart)							
6. Traditional Objective Tests:: _____Test Analysis (Midterm and Final Exam) _____Table of Specifications (not included) _____Test Item Bank (not included) 7.____New Midterm Exam 7.____New Final Exam 8. ___ Diagnostic Write Ups (MT & F)							
Performance Assessment & Rubrics: 7. _____ 3 Complex Performance Assessments with multiple tasks embedded 7._____3 Rubrics, one to score each Performance Assessment (And to be used with students to establish standards up front) 8._____ Diagnostic Write Ups (PA 1,2,3) *****_____ Copies of Students Rubrics (Hardcopies on file) 7._____ Electronic copies of tests and PAs & Rubrics **Other Assessments of Individual Choice: Yes for All**							
9. Student Centered Course Syllabus: _____All new components and check off list							
10. Professors' Research: **____ Completed Data Forms (including data on MT, F, PA1,2,3)** **____ Research Results Reports**							
12.___Teaching Portfolio Assessment Questionnaire **13___ Teaching Models Self Assessment** **14___ Teaching Styles Self Assessment** **15___ Student Learning Style Opportunities Assessment** **16___ Outcomes Achieved as Planned by Bloom & Dale Assessment**							
17. Manuscript to be submitted: **_____ Draft** **_____ Final Version to be submitted to journal (May, 2007)**							

Teaching Portfolio Assessment Process - May 25, 2006
CITL Professional Development Program
Jule Scarborough, 2006

Portfolio Product (Artifact) Content **Self Assessment Baseline:** _____Student Questionnaire _____Professor completion of Student Questionnaire _____Professor Self Competency Questionnaire	**Description of my Knowledge, Skills, Abilities on Feb. 2, 2006**	**Description of my Knowledge, Skills, Abilities on May 25th, 2006**
Course Analysis: _____GAPS Analysis on TM, TS, LS, B, D _____ABET/TAC/NAIT SLO by Bloom's Analysis _____Course Calendar by TM, TS, LS, B, D _____Teaching Models + Cooperative Learning + Mapping Study Chart		
Student Centered Course Syllabus: _____All new components and check off list		
Portfolio Product (Artifact) Content **Multifaceted Assessment System:** _____Course Assessment Plan Chart showing course assessments _____Assessment Analysis by Bloom (Chart) **Traditional Objective Tests:** _____Test Analysis _____Table of Specifications _____Test Item Bank _____New Midterm Exam _____New Final Exam _____Test Items by SLO Chart **Performance Assessment & Rubrics:** _____ 3 Complex Performance Assessments with multiple tasks embedded _____3 Rubrics, one to score each Performance Assessment (and to be used with students to establish standards up front) **Other Assessments of Individual Choice:** **List and Describe Here:** **1.___________________3.______________________** **2.___________________4.______________________**		

CEET Initiative on Teaching and Learning
Orientation Feedback

Feedback inquiries will change across the different types of modules with some constant items. However, both content assessment and quality feedback instruments will be used throughout the program. Below is a summary of faculty feedback offered by participants for the one-day orientation session.

1. Was today worth your time -- worthwhile?

Yes Not really

Why?

2. Would you recommend today's content for other faculty members?

Yes Not really

Why?

3. Will the survey data be a useful guide for instructional decision-making?

Yes Not really

Why?

4. Would you recommend that other faculty members get the opportunity to use the student survey?

Yes Not really

Why?

5. Was the "process" used today effective?

Yes Not really

Why?

6. Strengths of today's program.

7. Areas to improve today's program.

8. General comments:

CEET Initiative on Teaching and Learning
Analysis Feedback- Day 2

1. Was today worth your time – worthwhile?

Yes Not really

Why?

2. Would you recommend today's content for other faculty members?

Yes Not really

Why?

3. Would you recommend that other faculty members get the opportunity to engage in this preliminary analysis?

Yes

4. Was the "process" used today effective?

Yes Not really

Why?

5. Strengths of today's program.

6. Areas to improve today's program.

7. General Comments:

CEET Initiative on Teaching and Learning
Student Learning Outcomes – Days 4 & 5, March 2 & 23

1. Were these two days worth your time – worthwhile?
Yes Not really

Why?

2. Would you recommend the program content on Student Learning Outcomes for other faculty members?
Yes Not really

Why?

3. Did the presentation and handouts provide appropriate information to guide you in the development of student learning outcomes without overwhelming you with too much material?

Yes No, not really

Why?

4. Did the "student learning outcome" sessions help you to specify the knowledge, skills, and ability course content more clearly and to identify priorities more logically?

Yes No, not really – I had already done a pretty good job of content identification and prioritization

Why?

5. Did the "student learning outcome" session help you to develop new or enhanced student learning objectives?

Yes, they are more… (select all that apply)
a. intentional in content and result or outcome
b. results oriented - outcomes oriented in that they clearly state what students are to know about, know, or be able to do
c. specific in what knowledge, skill, ability is to be learned or extended by the student
d. measurable
e. observable
f. appropriately stated - using more definite verbs and nouns; they explain the purpose, provide context, situation, conditions, etc.
f. all of the above

Not really

Why?

6. In completing the calendar for the formal scheduling of course content, there is greater potential to
(select all that apply)
a. enhance or improve the course focus
b. provide a better format for on-going critical analysis of the course content as updates or changes are needed
b. enhance or improve the course content delivery
d. help me better visualize my course and how to continuously update, improve or enhance it to continuously increase student learning
e. provide the students with a clearer picture of the course and what they are to learn
f. help me and my students to stay on "course"
g. all of the above

Not really
Why?

6. Now that you have written student learning outcomes, do you feel more able to prepare learning activities or experiences?

Yes No, not really

Why?

7. Would you recommend that other faculty members get the opportunity to engage in revising their course Student Learning Outcomes - content identification and student learning outcomes?

Yes Not really – too soon to use until we finish our program and further explore its meaning

Why?

8. Was the "process" used during these days effective?

Yes Not really

Why?

9. Strengths of this aspect of the program.

10. Areas to improve in this aspect of the program.

11. General Comments:

CEET Initiative on Teaching and Learning
Gap Analysis Summary and Test Analysis Feedback- Day 3 – Feb. 16, 2006

1. Was today worth your time – worthwhile?

Yes Not really

Why?

2. Would you recommend today's content for other faculty members?

Yes Not really

Why?

3. Did the GAPs Analysis & Summary help you to see possibilities for extending or enhancing: course content and teaching/learning strategies; also, did it make you aware of models and techniques that you could consider using to build or extend student learning experiences to higher levels of learning?

Yes Not really

Why?

4. Would you recommend that other faculty members get the opportunity to engage in the preliminary aspect of test analysis?

Yes Not really – too soon to use until we finish our program and further explore its meaning

Why?

5. Was the "process" used today effective?

Yes Not really

Why?

6. Strengths of today's program.

7. Areas to improve today's program.

8. General Comments:

CEET Initiative on Teaching and Learning
Item Writing and Test Development – Days 6, 7, 8, 9 – March 30, April 6, 20, 27

1. **Were these four days worth your time – worthwhile?**

   Yes No, not really

   Why?

2. **Did the presentation and handouts provide appropriate information to guide you in item writing and test development without overwhelming you with too much material?**

   Yes No, not really

   Why?

3. **Were you able, during the four sessions, to write many appropriate and valid test items and to assemble what you would consider good tests or tests more fully developed than the ones you were using before now?**

   Yes No, not really

   Why?

4. **As a result of these four sessions do you now feel you have <u>greater</u> ability and confidence in writing items and developing tests?**

   Yes No, not really

   Why?

5. **Would you recommend that other faculty members have the opportunity to learn more about writing items and developing tests through workshops similar to these?**

   Yes No, not really – too soon to use until we finish our program and further explore its meaning

   Why?

6. **Was the "process" used during these days effective?**

   Yes No, not really

   Why?

7. **Strengths of this aspect of the progra**m.

8. **Areas to improve in this aspect of the program.**

9. **General Comments:**

CEET Initiative on Teaching and Learning - Performance Assessment Feedback, Jan. 2007

1. Was the time spent developing <u>performance tasks</u> worth your time -- worthwhile?

Yes Not really

Why?

2. Was the time spent developing <u>rubrics</u> for scoring the performance tasks worth your time -- worthwhile?

Yes Not really

Why?

3. Would you <u>recommend</u> the <u>performance task</u> program content for other faculty members?

Yes Not really

Why?

4. Would you <u>recommend</u> the <u>rubric</u> program content for other faculty members?

Yes Not really

Why?

5. Were the <u>performance tasks</u> a <u>beneficial</u> addition to the student assessment plan for your course?

Yes Not really

Why?

6. Were the <u>rubrics</u> <u>beneficial</u> for scoring the performance tasks?

Yes Not really

Why?

7. Were the <u>performance tasks</u> an <u>effective</u> tool for <u>enhancing</u> student learning?

Yes Not really

Why?

8. Were the <u>performance tasks</u> an <u>effective</u> tool for <u>measuring</u> student learning?

Yes Not really

Why?

9. Were the <u>rubrics</u> an <u>effective</u> tool for <u>scoring</u> the outcomes of student performances on the tasks?

Yes Not really

Why?

10. Were the <u>rubrics</u> <u>effective</u> in helping students to <u>understand</u> <u>more</u> about what you expected them to do by revealing the standards and scoring mechanism with them up front?

Yes Not really

Why?

11. Do you feel that more <u>formalized</u> <u>performance tasks</u> and rubrics <u>improved</u> the opportunity for students to provide <u>evidence</u> of learning?

Yes Not really

Why?

12. Would you <u>recommend</u> that other faculty members get the opportunity to learn about, develop, and use performance tasks and rubrics as student assessment tools?

Yes Not really -

Why?

13. Was the performance/rubric development process used with this group – "*developing while learning; presentation; examples; and, one-on-one feedback* - effective?

Yes Not really

Why?

14. Will you <u>continue</u> <u>to</u> use <u>performance</u> <u>tasks</u> and <u>rubrics</u> in this and/or other classes?

Yes Not really

Why?

14. Strengths of the performance task/rubric program component.

15. Areas to improve in the performance task/rubric program component.

16. General comments:

CEET Initiative on Teaching and Learning
Program Feedback- Final Feedback –December 15, 2006

1. Looking back, and after the research semester, do you feel that the faculty development sessions were worth your time – worthwhile?

Test Analysis and Development Review	Yes	Not really
Performance Assessment and Rubics	Yes	Not really
Analyzing all your assessments by Bloom	Yes	Not really
Consideration of “broader” assessments and mapping your assessments	Yes	Not really
Teaching Models, including Cooperative Learning and Mapping Analysis	Yes	Not really
The review of components for a more revealing syllabus for the students	Yes	Not really
The review and consideration of Multicultural aspects of courses.	Yes	Not really
The review and consideration of grading.	Yes	Not really
The educational Research Session	Yes	Not really

Overall, was the faculty development program worth your time and “worth while”? Yes Not really

Why or Why not to any of the above statements?

2. Would you recommend the overall program content as you experienced it for other faculty members?

Yes Not really

Why?

3. Was the Research Semester, performing experimental classroom research with students, worth your time and “worthwhile”?

Yes Not really

Why or Why not to any of the above statements?

4. Looking back at the semester, was the re-development of your course, or the changes to your course, worthwhile when used with students?

Yes, definitely Yes, most of them Yes, the majority of them Yes, some of them

Not as many of the changes were as valuable as I had hoped No, very few of them were successful changes

Why or Why not?

5. Were the teaching and learning materials developed during the faculty development sessions worthwhile when used with students?

Yes, definitely Yes, most of them Yes, the majority of them Yes, some of them

Not as many of the materials were as valuable as I had hoped No, very few of the materials were successful

Why or Why not?

6. From the perspective of the entire program, faculty development, the development of course and classroom materials, and the educational research semester, was it as a “whole” worth your time – worthwhile?

Yes Not really

Why or Why not?

7. Would you recommend that other faculty members get the opportunity to participate in this program with content modifications?

Yes Not really – too soon to determine

What changes would you suggest?

8. Was the learning and development "process" used during the entire program (including the May 15-25 time) effective?

Yes Not Really

Why?

9. Describe how you feel about the "products" you have developed, their purpose, usefulness, quality, etc.?

10. Describe teaching and learning process differences that you will implement in next fall's course?

11. Do you feel that the program dates worked…meaning some semester time and some summer time; our time was ½ days (9) in semester and ½ days (9) in May.

Worked well Would prefer a different schedule. Describe a preferred schedule for 18 days.

12. Strengths of the program overall.

13. Strengths of the learning and development process overall.

14. Areas to improve the overall program.

15. Areas to improve the learning and development process overall.

16. Dean Vohra would like the your Learning Community to continue and actively involve each of you together to continue to learn, share, and execute research on teaching and learning. At this point, although we don't have it well defined, are you willing to help define what "continued action" together means and then continue to participate?

Yes No, probably not

17. Did you learn or enhance "other" types of skills through the program process, e.g. computer or others?

18. General Comments about the overall program:

GAPS Analysis Summary

Standards ABET-Engineering

a. apply math, science, engineering	b. design/conduct experiments; analyze, interpret data	c. design system, component, process-given constraints, etc.	d. function on interdisciplinary teams	e. identify, formulate, solve engineering problems	f. understand professional, ethical responsibility	g. ability to communicate effectively	h. undst. impact eng. Sol global, economic, evnir., society	i. recognition of need for, and ability to engage in life-long learning	j. Knowledge in contemporary issues	k. ability to use techniques, skills, and modern engineering tools

Standards ABET/TAC/NAIT-Engineering Technology and Industrial Technology

a. mastery of knowledge, techniques, skills, modern tools	b. ability to apply current knowledge; adapt to emerging applications of math, science, technology	c. ability to conduct, analyze, interpret experiments; apply experimental results to improve processes	d. ability to apply creativity in design of systems, components, processes	e. ability to function effectively on teams	f. ability to identify, analyze, solve technical problems	g. ability to communicate effectively writing	h. ability to communicate effectively orally	i. recognize need for, ability to engage in lifelong learning	j. ability to understand professional, ethical, social responsibilities	k. respect for diversity; knowledge of contemporary professional, societal, global issues	l. commit to quality, timeliness, continuous improvement	m. ability to program computers and/or use computer applications effectively	n. ability to use modern laboratory techniques, skills, equipment effectively	o. ability to manage projects effectively	p. ability to design, manipulate, manage industrial systems	q. ability to manage or lead personnel effectively

NIU General Education

Writing	Speaking	Listening	Quantitative Reasoning	Use of Resources-Technology	Historical Development Of Culture	Significance of Arts	Cultural Traditions Philosophical Ideas	Methods in Science Methods in Social Science	Interrelatedness Across Disciplines	Social Responsibility Citizenship

Student Learning Outcomes & Teaching Models

Outcomes	**Mem**	**Prog Part**	**Adv O**	**Lec**	**Rec Tch**	**Mast Learn**	**Coop Learn**	**Graphic Org**	**Concept Attainm**	**Conc Form**	**Conc Pres**	**Con-ceptual**	**Induct**	**Deduct**	**Inquiry**	**Sim-ulate**	**JurisP**	**Direct Instr**	**Train**	**Synect**	**Psycho-motor**	**Meta-phore**	**Non-direct**	**Role**

Student Learning Outcomes & Teaching Styles

Outcomes	**Command**	**Practice**	**Reciprocal**	**Self-Check**	**Inclusion**	**Guided Discovery**	**Convergent Discovery**	**Divergent Production**	**Learner Designed**	**Learner Initiated**	**Self Teaching**

Student Learning Objectives/Outcomes & Learning Styles

Objectives	Concrete Experience	Abstract Conceptualization	Active Experimentation	Reflective Observation

Student Learning Objectives/Outcomes & Bloom & Dale

Objectives	Dale's Cone Levels P A A+	Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Create	Critical Thinking Level L M H

CEET Initiative on Teaching and Learning
Program Feedback- (Final Feedback, end of development, before classroom resesearch semester) – May 15-25

1. Were the sessions May 15-25 worth your time – worthwhile?

Test Analysis and Development Review	Yes	Not really
Performance Assessment and Rubics	Yes	Not really
Analyzing all your assessments by Bloom	Yes	Not really
Consideration of "broader" assessments and mapping your assessments	Yes	Not really
Teaching Models, including Cooperative Learning and Mapping Analysis	Yes	Not really
The review of components for a more revealing syllabus for the students	Yes	Not really
The consideration of Multicultural aspects of courses.	Yes	Not really
The consideration of grading.		
The Research Session	Yes	Not really

Why?

2. From the perspective of the entire program, was it as a "whole" worth your time – worthwhile?

Yes Not really

Why?

3. Would you recommend the overall program content as you experienced it for other faculty members?

Yes Not really

Why?

4. Would you recommend that other faculty members get the opportunity to participate in this program with content modifications?

Yes Not really – too soon to determine

What changes would you suggest?

5. Was the learning and development "process" used during the entire program (including the May 15-25 time) effective?

Yes Not Really

Why?

6. Describe how you feel about the "products" you have developed, their purpose, usefulness, quality, etc.?

7. Describe teaching and learning process differences that you will implement in next fall's course?

8. Do you feel that the program dates worked…meaning some semester time and some summer time; our time was ½ days (9) in semester and ½ days (9) in May.

(7) Worked well Would prefer a different schedule. Describe a preferred schedule for 18 days.

9. Strengths of the program overall.

10. Strengths of the learning and development process overall.

11. Areas to improve the overall program.

12. Areas to improve the learning and development process overall.

13. Dean Vohra would like the your Learning Community to continue and actively involve each of you together to continue to learn, share, and execute research on teaching and learning. At this point, although we don't have it well defined, are you willing to help define what "continued action" together mean and then continue to participate?

(7) Yes No, probably not

14. Did you learn or enhance "other" types of skills through the program process, e.g. computer or others?

15. General Comments about the overall program:

CEET Initiative on Teaching and Learning
Final Program Feedback (end of research semester)- December 15, 2006

1. Looking back, and after the research semester, do you feel that the faculty development sessions were worth your time – worthwhile?

-Course Analysis (e.g., content gap analysis & priority, learning styles, teaching models & styles, standards & learning objectives/outcomes, objectives and test item match, Bloom's Taxonomy, Dale's Cone, Critical Thinking, and more)	Yes	Majority	Not really
-Test Analysis and Test Development Review	Yes	Majority	Not really
- Performance Assessment and Rubrics	Yes	Majority	Not really
-Analyzing all your assessments by Bloom	Yes	Majority	Not really
- Consideration of "broader" assessments and mapping your assessments	Yes	Majority	Not really
-Teaching Models, including Cooperative Learning and Mapping Analysis	Yes	Majority	Not really
-The review of components for a more revealing syllabus for the students	Yes	Majority	Not really
-The review and consideration of Multicultural aspects of courses.	Yes	Majority	Not really
-The review and consideration of grading.	Yes	Majority	Not really
-The educational Research Session	Yes	Majority	Not really
-Overall, was the faculty development program worth your time & "worth while"?	**Yes(6)**	**Majority(1)**	**Not really**

****Why or Why not to any of the above statements?

2. Would you recommend the overall program, including the program content as you experienced it, for other faculty members?

Yes, definitely   Yes, the greater majority of it   Some of it   Not really

****Why or why not?

3. Looking back at the semester, were the modifications made to your course, or the changes to your course, worthwhile and effective with students?

Yes, definitely-they improved the course and instruction   Yes, the majority of them improved the course and instruction

Yes, some of them improved the course and instruction

Not as many of the changes were as valuable as I had hoped   No, very few of them were successful changes

****Why or Why not?

4. Were the teaching and learning materials developed during the faculty development sessions effective when used with students during the research semester?

Yes, definitely   Yes, greater the majority of them   Yes, some of them

Not as many of the materials were as valuable as I had hoped   No, very few of the materials were successful

****Why or Why not?

5. Describe how you feel about the "products" you have developed, their purpose, usefulness, quality, etc.?

Analysis products – gaps analysis, teaching models and styles analysis, learning styles analysis, course content Analysis

Syllabus –

Tests –

Test Analyses -

Performance Assessments -

Rubrics –

Choices of teaching models and processes –

6. Was the Research Semester, performing experimental classroom research with students, worth your time and "worthwhile"?

Yes, very valuable, beneficial in the following ways:
__ provided evidence of the benefit of the course, teaching, learning, content, test, etc. gaps analyses and what was learned from them and developed as a result of identifying the gaps through the analysis processes

__ provided opportunity to evaluate and see benefits of new teaching and learning or educational products

__ provided opportunity to evaluate and see benefits of new teaching and learning processes

__ provided opportunity to evaluate and see benefits of new teaching models and styles

__ provided insight into student learning

__ provided insight about my teaching

__ provided opportunity for a first attempt at educational research – scholarship of teaching

__ identify and list others:

Not really as valuable as I had hoped: describe why for each item below:

____ provided evidence of the benefit of the course, teaching, learning, content, test, etc. gaps analyses and what was learned from them and developed as a result of identifying the gaps through the analysis processes

____provided opportunity to evaluate and see benefits of new teaching and learning or educational products

____provided opportunity to evaluate and see benefits of new teaching and learning processes

____ provided opportunity to evaluate and see benefits of new teaching models and styles

____provided insight into student learning

____provided insight about my teaching

____provided opportunity for a first attempt at educational research – scholarship of teaching

__ identify and list others:

7. Would you recommend to other faculty members that they begin to engage in research on teaching and learning?

Yes, definitely Yes, definitely, but after participating in the faculty development to prepare them

No, not really

*******Why? Specifically, what would keep you from recommending that others engage in classroom research on teaching and learning? Please describe in detail.**

8. From the perspective of the entire program, faculty development, the development of course and classroom materials, and the educational research semester, was the entire program - beginning with analysis through classroom research- as a "whole" program, worth your time – worthwhile?

Yes The greater majority Some of it Really, Not much

******Specifically, Why or Why not?**

9. Would you recommend that other faculty members get the opportunity to participate in this "whole" program, including faculty development, course development, and classroom research ?

Yes, definitely   Yes, with a few content changes   Yes, with many content changes?   No, not really

10. Specifically, what content changes would you suggest?

11. Was the learning and development "process" used during the entire program (Oct.05-research, Dec.06) effective?

Yes, definitely   Yes, with a few process changes   Yes, with many process changes   No, not really
No response

****Why?

12. Specifically, what process changes would you suggest? ****Why?

13. Specifically, what about the program, overall, would keep you from recommending it to other faculty members?

14. Identify and/or describe the teaching and learning changes that you implemented in the research semester's course:

____ Improved priority of course content

____ New syllabus with many new components

____ Clear learning objectives/outcomes tied to ABET/NAIT standards

____ Learning Style Inventory, e.g. Kolb, Felder, other

____ New teaching models
Identify, for example:
Small groups
One minute papers

____ New teaching styles

____ New objective tests

____ New performance assessments/Rubrics

____ New grading criteria – clear and pre-determined, no curving of grades, or last minute non-criteria-based judgments, etc.

____ Better alignment of syllabus, teaching, and assessment.

____Identify and list others specific to you.

15. Do you feel that the program dates worked…recall that some time was spent during the regular semesters and some time during the summer; specifically there was ½ or 9 days across the regular semesters and ½ or 9 days in May, plus 2 fall meetings, and the final meeting?

Worked well   Would prefer a different schedule
No response

****Describe a preferred schedule for 18 days, plus several short meetings

16. Describe the strengths of the overall program content.

17. Describe the strengths of the overall learning and development process.

18. Describe the areas you would like to see improvements in regarding the overall program content AND specify the desired improvements.

19. Describe the areas to you would like to see improvements in related to the overall learning and development process AND specify the desired improvements.

20. Dean Vohra would like your Learning Community to continue and actively involve each of you together to continue to learn, share, and execute research on teaching and learning. At this point, although we don't have it well defined, are you willing to help define what "continued action" together means and then continue to participate?

Yes, definitely No, probably not – Why?

It will depend upon….? Describe for you.

21. Other General Comments about the overall program:

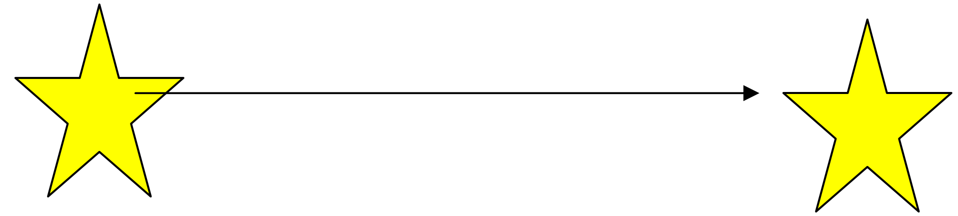
Tech 496 TAC-NAIT Learning Outcome-General Education Example

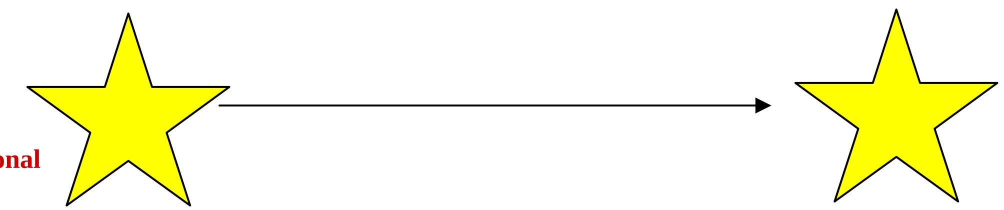
ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension: Knowledge / Remember — Comprehension / Understand — Application / Apply — Analysis / Analyze — Synthesis / Evaluate — Evaluate / Create
A. Mastery of knowledge, techniques, skills, modern tools of disciplines.	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**6. To demonstrate effective project** **a. planning** **b. initiation** **c. execution** **d. termination**	
B. Apply current knowledge and adapt to emerging applications of math, science, engineering, and technology. **NIU Gen Ed Goals -** ***Students:*** ***a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**8. To integrate mathematics, the sciences, communication, management, technical, and technological knowledge and skills to accomplish team and project objectives.**	
C. Conduct, analyze, and interpret experiments; apply experimental results to improve processes. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:		**NA**	

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes
D. ability to apply creativity in the design of systems, components, or processes appropriate to program objectives. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**8. To integrate mathematics, the sciences, communication, management, technical, technological knowledge and skills to accomplish team and project objectives.** **a. design a vehicle to technical specifications** **b. build the vehicle to technical specifications** **c. solve technical problems associated with design, construction, and evaluation** **d. test and evaluate vehicle against technical specifications**
E. Function effectively on teams. **NIU Gen Ed Goals-Students:** ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge √ Meta-cognitive Knowledge:	Active	**1. To identify and describe major problems, Issues, concerns, and solutions that relate to projects, PM, Pteams, and Pleaders, international projects and multi-cultural teams.** **2. To identify and describe best practices for managing projects and leading teams, including international projects and multi-cultural teams.** **3. To perform effectively on a project team (multi-cultural when possible)** **a. To engage in conflict resolution to resolve team issues.**

Bloom's Cognitive Process Dimension

Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create





ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension Knowledge Remember / Comprehension Understand / Application Apply / Analysis Analyze / Synthesis Evaluate / Evaluate Create
F. Identify, analyze, and solve technical problems. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**8. To integrate mathematics, the sciences, communication, management, technical, technological knowledge and skills to accomplish team and project objectives.** **a. design a vehicle to technical specifications** **b. build the vehicle to technical specifications** **c. solve technical problems associated with design, construction, and evaluation** **d. test, evaluate vehicle against technical specifications.**	
G. Communicate effectively in writing. **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**9. To design, develop, prepare, and deliver** **a. executive team presentation** **b. team portfolio** **c. team website**	

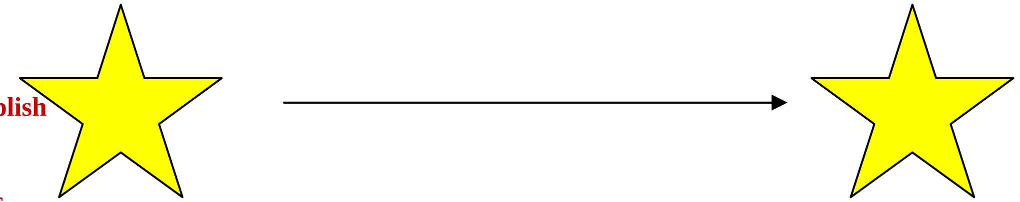
ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension: Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
H. Communicate effectively orally. **NIU Gen Ed Goals - Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.*** a***ii. communicate in a manner that unites theory, criticism, and practice in speaking & writing.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**7. To demonstrate effective project** **a. planning** **b. initiation** **c. execution** **d. termination** **9. To design, develop, prepare, and deliver** **a. team presentation** **b. team portfolio** **c. team website**						
I. Recognize the need for, and an ability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv.** ***are able to access and use various information sources. Internet, text, and field case.***	√ Factual Knowledge: √ Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:	Intermdeidate **Active**	**1. To identify and describe major problems, issues, concerns, and solutions that relate to projects, project management, project teams, and project leaders, including international projects and multi-cultural teams.** **2. To identify and describe best practices for managing projects and leading teams, including international projects and multi-cultural teams.**						
J. Understand professional, ethical, and social responsibilities. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	√ Factual Knowledge: √ Conceptual Knowledge: √ Procedural Knowledge: √ Meta-cognitive Knowledge:	Active	**5. To exhibit leadership by engaging in a team community service project.**						

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension: Knowledge Remember / Comprehension Understand / Application Apply / Analysis Analyze / Synthesis Evaluate / Evaluate Create
K. Respect for diversity and a knowledge of contemporary professional, societal, and global issues. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-cognitive Knowledge:	Active	**3. To perform effectively on a project team (multi-cultural when possible).** **a. To engage in conflict resolution to resolve team issues.**	
L. Commitment to quality, timeliness, and continuous improvement.	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-cognitive Knowledge:	Active	**6. To demonstrate effective project** **a. planning** **b. initiation** **c. execution** **d. termination** **3. To perform effectively on a project team (multicultural when possible)** **a. To engage in conflict resolution to resolve team issues.** **8. To integrate mathematics, the sciences communication, management, technical and team and project objectives.** **a. design a vehicle to technical specifications** **b. build the vehicle to technical specifications** **c. solve technical problems associated with project design, construction, and evaluation** **d. test and evaluate vehicle against technical specifications**	
M. Ability to program computers and/or utilize computer applications effectively.	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-Cognitive Knowledge:	Active	**6. To demonstrate effective project** **a. planning** **b. initiation** **c. execution** **d. termination**	

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes
N. Ability to use modern laboratory techniques, skills, and/or equipment effectively.	√Factual Knowledge: √Conceptual Knowledge: √Procedural Knowledge: √Meta-Cognitive Knowledge:	Active	**8. To integrate mathematics, the sciences communication, management, technical and technological knowledge and skills to accomplish team and project objectives.** **a. design a vehicle to technical specifications** **b. build the vehicle to technical specifications** **c. solve technical problems associated with project design, construction, and evaluation** **d. test and evaluate vehicle against technical specifications**

Bloom's Cognitive Process Dimension

Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create



ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Outcomes	Bloom's Cognitive Process Dimension

Bloom's Cognitive Process Dimension: Knowledge / Remember; Comprehension / Understand; Application / Apply; Analysis / Analyze; Synthesis / Evaluate; Evaluate / Create

O. Ability to manage projects effectively.

> **NIU Gen Ed Goals - Students:**
> ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***

√Factual Knowledge:

√Conceptual Knowledge:

√Procedural Knowledge:

√Meta-cognitive Knowledge:

Active

1. To identify an describe major problems, issues, concerns, and solutions that relate to projects, Pmanagement, P teams, and P leaders, including international projects and leading Multi-cultural teams.

2. To identify and describe best practices for managing projects and leading teams, including international projects and multi-cultural teams.

3. To perform effectively on a project team (multi-cultural team when possible).

Active

4. To prepare the team for project work by
a. developing a team operations manual
b. developing a peer and team assessment system
c. creating the team organization and process
d. developing a team project plan

6. To demonstrate project
a. planning
b. initiation
c. execution
d. termination
e. problem solving

7. To demonstrate effective use of project management techniques and tools in the management of a technical project.
a. the development of a project plan
b. use of MS Project
c. use of appropriate financial planning and operations procedures
d. use of appropriate procurement procedures
e. scheduling techniques
f. use of the MACE process

9. To design, develop, prepare, and deliver
a. executive team presentation
b. team portfolio
c. team website

ABET/TAC/NAIT Engineering & Technology | **Bloom's Knowledge Dimension** | **Dale's Cone** | **Student Learning Outcomes** | **Bloom's Cognitive Process Dimension**

Knowledge Remember | **Comprehension Understand** | **Application Apply** | **Analysis Analyze** | **Synthesis Evaluate** | **Evaluate Create**

P. Ability to design, manipulate, and manage industrial systems.

NIU Gen Ed Goals - Students:
c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and

Factual Knowledge:

Conceptual Knowledge:

Procedural Knowledge:

Meta-cognitive Knowledge:

NA

Q. Ability to manage or lead personnel effectively.

√Factual Knowledge:

√Conceptual Knowledge:

√Procedural Knowledge:

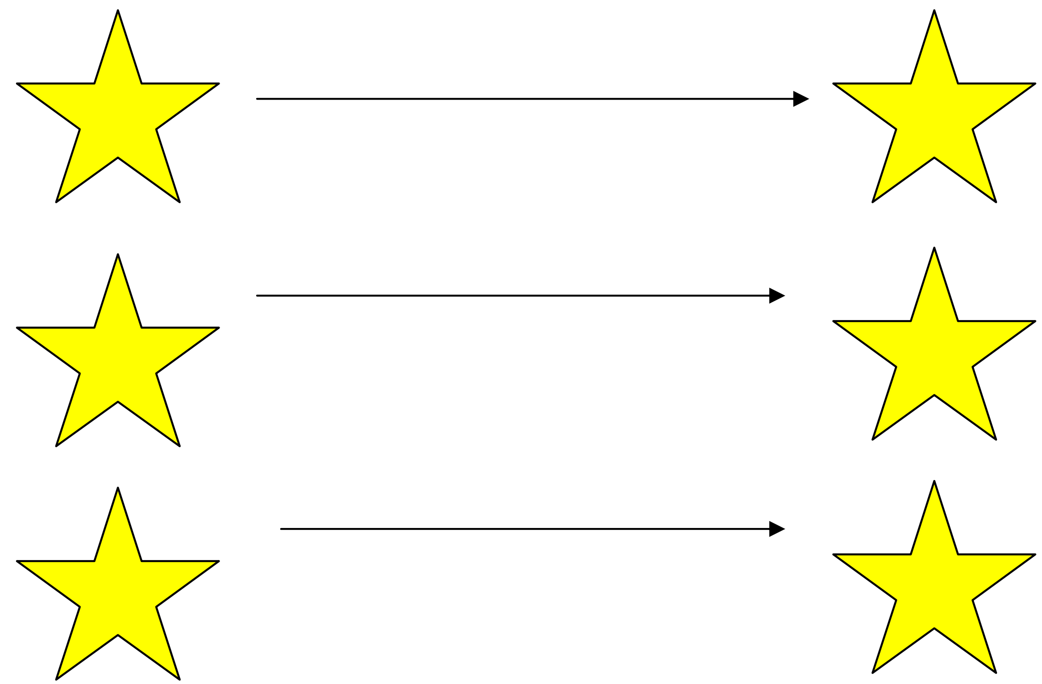
√Meta-cognitive Knowledge:

Active

3. To perform effectively on a project team (multi-cultural when possible).
a. To engage in conflict resolution to resolve team issues.
b. To engage in the leadership of the team, team members, or work package sub-team members.

4. The team will prepare project work by
a. developing a team operations manual
b. developing a peer and team assessment system
c. creating the team organization and process
d. developing a team project plan

5. To exhibit leadership while engaged in a team community service project
a. plan
b. initiate
c. execute
d. terminate
e. report



Addition: additional educational outcomes articulated by the overall program ** See in text boxes above - NIU General Education Goals

ABET Engineering Objective Worksheet

ABET Engineering Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
A. Apply knowledge of math, science, engineering **NIU Gen Ed Goals -** ***Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
B. Design and conduct experiments; analyze and interpret data **NIU Gen Ed Goals -** ***Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
C. Design a system, component, process to meet desired needs within realistic constraints (e.g., economic, environmental, social, political, ethical, health, safety, manufacturability, & sustainability). **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
D. Function on multi-disciplinary teams. **NIU Gen Ed Goals-** **Students:** ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
E. Identify, formulate, and solve engineering. problems **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
F. Understand professional and ethical responsibility **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
G. Communicate effectively **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
H. understand impact of engineering solutions in a global economic, environmental, societal context **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
I. Recognize the need for, and have capability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv.** ***are able to access and use various information sources. Internet, text, and field case.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
J. knowledge of contemporary issues **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET Engineering Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
K. use techniques, skills, and modern engineering tools necessary for engineering practice	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

Addition: Additional educational outcomes -NIU General Education Goals - articulated by the overall program

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
A. Mastery of knowledge, techniques, skills, modern tools of disciplines.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
B. Apply current knowledge and adapt to emerging applications of math, science, engineering, and technology. **NIU Gen Ed Goals -** ***Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
C. Conduct, analyzes, and interprets experiments; apply experimental results to improve processes. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

ABET/TAC/NAIT Engineering & Technology Outcomes	Bloom's Knowledge Dimension √ on left side of type of knowledge that applies to outcome	Dale's Cone of Learning Passive Active	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
D. Ability to apply creativity in the design of systems, components, or processes appropriate to program objectives. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

<table>
<tr><th rowspan="2">ABET/TAC/NAIT Engineering & Technology Outcomes</th><th rowspan="2">Bloom's Knowledge Dimension
√ on left side of type of knowledge that applies to outcome</th><th>Dale’s Cone of Learning</th><th rowspan="2">Student Learning Objectives</th><th colspan="6">Bloom’s Cognitive Process Dimension</th></tr>
<tr><th>Passive
Active</th><th>Knowledge
Remember</th><th>Comprehension
Understand</th><th>Application
Apply</th><th>Analysis
Analyze</th><th>Synthesis
Evaluate</th><th>Evaluate
Create</th></tr>
<tr><td>E. Function effectively on teams.

NIU Gen Ed Goals-Students:
b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.
d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.</td><td>Factual Knowledge

Conceptual Knowledge

Procedural Knowledge

Meta-Cognitive Knowledge</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

F. Identify, analyze, and solve **technical problems.** **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
G. Communicate effectively in writing. **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

H. Communicate effectively orally. **NIU Gen Ed Goals - Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.*** a***ii. communicate in a manner that unites theory, criticism, and practice in speaking & writing.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
I. Recognize the need for, and an ability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv.** ***are able to access and use various information sources. Internet, text, and field case.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
J. Understand professional, ethical, and social responsibilities. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

K. Respect for diversity and a knowledge of contemporary professional, societal, and global issues. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
L. Commitment to quality, timeliness, and continuous improvement.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
M. Ability to program computers and/or utilize computer applications effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
N. Ability to use modern laboratory techniques, skills, and/or equipment effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

O. Ability to manage projects effectively. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
P. Ability to design, manipulate, and manage industrial systems. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and***	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								
Q. Ability to manage or lead personnel effectively.	Factual Knowledge Conceptual Knowledge Procedural Knowledge Meta-Cognitive Knowledge								

Addition: Additional educational outcomes -NIU General Education Goals - articulated by the overall program

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
a. apply knowledge of math, science, engineering	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge								
b. design and conduct experiments; analyze and interpret data	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
c. design a system, component, process to meet desired needs within realistic constraints, e.g. economic, environmental, social, political, ethical, health, safety, manufacturability, & sustainability	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
d. function on multi-disciplinary teams	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
e, identify, formulate, solve engineering problems	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge Conceptual Knowledge								
f. understand professional and ethical responsibility	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
g. communicate effectively \	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
h. understand impact of engineering solutions in a global economic, environmental, societal context	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								

ABET Engineering Outcomes	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
i. recognize need for and have capability to engage in life long learning	Factual Knowledge:								
	Conceptual Knowledge:								
	Procedural Knowledge:								
	Meta-cognitive Knowledge:								
j. knowledge of contemporary issues	Factual Knowledge:								
	Conceptual Knowledge:								
	Procedural Knowledge:								
	Meta-cognitive Knowledge:								
k. use techniques, skills, and modern engineering tools necessary for engineering practice	Factual Knowledge:								
	Conceptual Knowledge:								
	Procedural Knowledge:								
	Meta-cognitive Knowledge:								

Addition: additional educational outcomes articulated by the overall program NIU General Education Goals

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
A. Mastery of knowledge, techniques, skills, modern tools of disciplines.	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
B. Apply current knowledge and adapt to emerging applications of math, science, engineering, and technology. **NIU Gen Ed Goals - *Students: a.iii. perform basic computations, display facility with use of formal and quantitative reasoning analysis and problem solving, and interpret mathematical models and statistical information.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
C. Conduct, analyze, and interpret experiments; apply experimental results to improve processes. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences. b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
D. ability to apply creativity in the design of systems, components, or processes appropriate to program objectives.	Factual Knowledge:								
	Conceptual Knowledge:								
	Procedural Knowledge:								
NIU Gen Ed Goals - Students: ***c. develop an understanding of the relatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Meta-cognitive Knowledge:								
E. Function effectively on teams.	Factual Knowledge:								
NIU Gen Ed Goals-Students: ***b.iii. demonstrate a knowledge of cultural traditions and philosophical ideas that have shaped societies, civilizations, and human self-conceptions.*** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Conceptual Knowledge:								
	Procedural Knowledge								
	Meta-cognitive Knowledge:								

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
F. Identify, analyze, and solve technical problems. **Gen Ed Goals - Students:** ***b. develop an ability to use modes of inquiry across a variety of disciplines in the humanities and the arts, the physical sciences and mathematics, and social sciences.*** ***b.iv. demonstrate an ability to use scientific methods and theories to understand the phenomena studied in the natural and social sciences.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
G. Communicate effectively in writing. **NIU Gen Ed Goals- Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
H. Communicate effectively orally. **NIU Gen Ed Goals - Students:** ***a. develop habits of writing, speaking, and reasoning necessary for continued learning.*** ***a.i. communicate clearly in written English, demonstrating ability to comprehend, analyze, and interrogate critically.*** a***ii. communicate in a manner that unites theory, criticism, and practice in speaking & writing.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
I. Recognize the need for, and an ability to engage in life long learning. **NIU Gen Ed Goals - Students:** **a.iv.** ***are able to access and use various information sources. Internet, text, and field case.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
J. Understand professional, ethical, and social responsibilities. **NIU Gen Ed Goals - Students:** ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension: Knowledge Remember	Comprehension Understand	Application Apply	Analysis Analyze	Synthesis Evaluate	Evaluate Create
K. Respect for diversity and a knowledge of contemporary professional, societal, and global issues.	Factual Knowledge:								
	Conceptual Knowledge:								
NIU Gen Ed Goals - Students: ***d. develop social responsibility and preparation for citizenship through global awareness, environmental sensitivity, and an appreciation of cultural diversity.***	Procedural Knowledge:								
	Meta-cognitive Knowledge:								
L. Commitment to quality, timeliness, and continuous improvement.	Factual Knowledge:								
	Conceptual Knowledge:								
	Procedural Knowledge:								
	Meta-cognitive Knowledge:								
M. Ability to program computers and/or utilize computer applications effectively.	Factual Knowledge:								
	Conceptual Knowledge:								
	Procedural Knowledge:								
	Meta-Cognitive Knowledge:								
N. Ability to use modern laboratory techniques, skills, and/or equipment effectively.	Factual Knowledge:								
	Conceptual Knowledge:								
	Procedural Knowledge:								
	Meta-Cognitive Knowledge:								

ABET/TAC/NAIT Engineering & Technology	Bloom's Knowledge Dimension	Dale's Cone	Student Learning Objectives	Bloom's Cognitive Process Dimension					
				Knowledge Remember	**Comprehension Understand**	**Application Apply**	**Analysis Analyze**	**Synthesis Evaluate**	**Evaluate Create**
O. Ability to manage projects effectively. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and issues.***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
P. Ability to design, manipulate, and manage industrial systems. **NIU Gen Ed Goals - Students:** ***c. develop an understanding of the interrelatedness of various disciplines by integrating knowledge from several disciplines and applying that knowledge to an understanding of important problems and***	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								
Q. Ability to manage or lead personnel effectively.	Factual Knowledge: Conceptual Knowledge: Procedural Knowledge: Meta-cognitive Knowledge:								

Addition: additional educational outcomes articulated by the overall program ** See in text boxes above - NIU General Education Goals

Tech 496 Industrial Project Management

Student Learning Objectives and Outcomes **Students will be able to:**	**Assessments: Tests Midterm & Final**
1. Identify and describe major problems, issues, concerns, and solutions that relate to projects, project management, project teams, and project leaders: Identify problems, issues, concerns, and solutions (PICS) that a. occur during projects b. relate to project management c. occur during team engagement on projects between team members and/or team leaders d. occur for team leaders of projects e. are specific to international projects f. occur during projects that are executed by a multi-cultural teams and involve ethnically diverse team members working together g. are specific to team leaders of international projects and/or multicultural teams executing projects	
2. Identify and describe best practices for managing projects and leading teams, including international projects and multi-cultural teams.	
3. Perform effectively on a team to complete a technical project and community service project (multicultural team when possible). a. To engage in the leadership of team members or work package groups b. To engage in conflict resolution to resolve team issues. c. To perform team and peer assessments throughout the project.	
4. Prepare the team for project work by a. developing a team operations manual b. developing a peer and team assessment system c. creating the team organization and process d. developing a team project plan	
5. Exhibit leadership while engaged in a team community service project. a. plan b. initiate c. execute d. terminate	
6. Demonstrate effective project a. planning b. initiation c. execution d. evaluation e. termination f. problem solving	
7. Demonstrate effective use of project management techniques and tools in the management of a technical project. a. planning b. MS Project c. finance procedures d. procurement procedures e. scheduling f. MACE	
8. Integrate mathematics, the sciences, communication, management, technical and technological knowledge and skills to accomplish team and project objectives. a. design a vehicle to technical specifications b. build the vehicle to technical specifications c. solve technical problems associated with project design, construction, and evaluation d. test and evaluate the vehicle to technical specifications	
9. Design, develop, prepare, and deliver a. executive team presentation b. team portfolio c. team website	

Tech 496 Industrial Project Management

Student Learning Objectives and Outcomes **Students will be able to:**	**Corresponding Assessments:**
1. Identify and describe major problems, issues, concerns, and solutions that relate to projects, project management, project teams, and project leaders: Identify problems, issues, concerns, and solutions (PICS) that: a. occur during projects b. relate to project management c. occur during team engagement on projects between team members and/or team leaders d. occur for team leaders of projects e. are specific to international projects f. occur during projects that are executed by a multi-cultural teams and involve ethnically diverse team members working together g. are specific to team leaders of international projects and/or multicultural teams executing projects	Text Project Literature Study Paper Case Study Career Project Team Project
2. Identify and describe best practices for managing projects and leading teams, including international projects and multi-cultural teams.	Literature Study; Text Project Case Study; Paper, Team Project
3. Perform effectively on a project team (hopefully multicultural team) to complete a technical project. a. To engage in the leadership of team members or work package groups b. To engage in conflict resolution to resolve team issues. c. To perform team and peer assessments throughout the project d. To execute a technical project	Team Participation Assessment Team Assessment Professor's Assessment Team Project Outcomes
4. Prepare the team for project work by a. developing a team operations manual b. developing a peer and team assessment system c. creating the team organization and process d. developing an individual project plan e. participating in the development of a team project plan	Team Operating Manual Peer Assessment System Use of Peer Assessment System Team Plan
5. Exhibit leadership and/or participation while engaged in a team community service project. a. plan b. initiate c. execute d. terminate	Service Project Report & Evaluation
6. Demonstrate effective project a. planning b. initiation c. execution d. evaluation e. termination f. problem solving g. leadership	Individual Project Plan Individual Portfolio Peer Assessment Team Assessment Team Participation Assessment Project Feedback logs Team Project Plan Team Project portfolio, presentation, website
7. Demonstrate effective use of project management techniques and tools in the management of a technical project. a. planning b. execution c. termination b. MS Project c. finance procedures d. procurement procedures e. scheduling f. MACE procedures and process	Individual Project Plan MS Project Test Individual Portfolio Peer Assessment Team Assessment Team Plan Team presentation, portfolio, and website

8. Integrate mathematics, the sciences, communication, management, technical and technological knowledge and skills to accomplish team and project objectives. a. design a vehicle to technical specifications b. build the vehicle to technical specifications c. solve technical problems associated with project design, construction, and evaluation d. test and evaluate the vehicle to technical specifications	Individual Project Research Individual Project Design Individual Portfolio
9. Design, develop, prepare, and deliver a. executive team presentation b. team portfolio c. team website	Team Presentation Team Portfolio Team Website

VI. Course Topics, Class Schedule & Due Dates

Week & Objectives		Day 1 Topics/Lab Activities. Due Dates		Day 2 Topics/Lab Activities. Due Dates
Week 8/28				
Week 9/4				
Week 9/11				
Week 9/18				
Week 9/25				
Week 10/2				
Week 10/9				
Week 10/16 - MIDTERM				
Week 10/23				
Week 10/30				
Week 11/6				
Week 11/13				
Week 11/20				11/23 THANKSGIVING
Week 11/27				
Week 12/4				
Week 12/11 FINAL EXAM				

VI. Course Topics, Class Schedule & Due Dates

Week & Objectives		Day 1 Topics/Lab Activities. Due Dates		Day 2 Topics/Lab Activities. Due Dates		Day 3 Topics/Lab Activities Due Dates
Week 8/28						
Week 9/4						
Week 9/11						
Week 9/18						
Week 9/25						
Week 10/2						
Week 10/9						
Week 10/16 - MIDTERM						
Week 10/23						
Week 10/30						
Week 11/6						
Week 11/13						
Week 11/20						11/23 THANKSGIVING
Week 11/27						
Week 12/4						
Week 12/11 FINAL XAM						

Technology 496 - Industrial Project Management – Spring 2004

Prof: Dr. Scarborough **Grad. Asst:** ________________ **Ph:** 753-0210(Dr. Scarborough)/1570(GA)
Off.Hrs: T12-3 **Email:** scarboro@ceet.niu.edu

I. Catalog Course Description: Industrial Project Management (3). Basic concepts, principles, and skills of project management. Designed to cover a variety of types of project management. Emphasis on computer tools and project management techniques. Analysis of case studies. Culminating project required.

II. Course Purpose: To prepare project leaders and team members to formally initiate, execute and terminate industrial projects effectively. To integrate and apply knowledge, skills, and abilities acquired or extended during students' college careers (general education and major) and work experience to research, design, build and finalize a technical project within a team environment.

III. Required Text: **Project Management**. Cleland & Ireland, 2002, fourth edition. **Required: Datebook/calendar for scheduling and notes; Handout packet**

IV. Pre-requisites: Tech 265-Mfg. Processes, Tech 302- Graphic Pres. & Comm., Tech 395-Industrial Data Processing**, Senior Status**

Expected Computer Usage: CAD, MS Office, MS Project, other, depending upon semester/ team project. **Required Laboratory Team Project:** Changes each semester; each team will engage in a complex technical project with specific technical standards to achieve, e.g. Go-kart, 3-car passenger train, hovercraft, paddle wheel boat, personal transport vehicle etc. Research, design, assembly of electrical/mechanical systems, testing, modifications/finalization with formal documentation, formal team products and team requirements. See requirements section, handouts, and rubrics.

V. Student Learning Outcomes	Embedded NIU General Ed Goals	Embedded NAIT/ABET Learning Standards	Assessments/Rubrics
1A/B. Identify and describe major problems, issues, concerns, and solutions that relate to (a) projects, (b) project management, (c) project teams, and (d) project leaders, also for (e) Int'l projects and (f) multicultural (MC) teams: Identify PICS – problems, issues, concerns, and solutions for each. **2. Identify and describe best practices for managing projects and leading teams; include Int'l teams and MC teams.**	**a.i.** communicate clearly in English, demonstrating ability to comprehend, analyze and interrogate critically; **ii.** communicate in a manner that unites theory, criticism, practice in speaking & listening; **a.iv.** Aware of and able to use various resources, including modern technology	**g.**demonstrate an ability to communicate effectively in writing**;** **h.** demonstrate an ability to communicate effectively orally; **m.** demonstrate an ability to ….utilize computer applications effectively**;** **k.** demonstrates a respect for diversity and knowledge of contemporary professional, societal and global issues.	Text Project or Text Test Research Literature/Internet; GP Case study; group analysis process Formal paper; group analysis 5 minute learning papers; Individual portfolios; Project portfolio/website; Individual/team presentations Team participation & Peer Assessment Team Operating Manual Individual and Team Project Plan
3a. To demonstrate effective project: **a. planning,** **b. initiation,** **c. execution,** **d. termination** **e. evaluation** **f. problem solving** **g. leadership** **3b. Design, develop, and deliver:** **e. executive team presentation** **f. team portfolio** **g. team website**	**a.i.** communicate clearly in English, demonstrating ability to comprehend, analyze and interrogate critically; **ii.** communicate in a manner that unites theory, criticism, practice in speaking & listening; **a.iii**.perform basic computations, display facility with use of quantitative reasoning in forming concepts for analysis and in problem solving, and interpret mathematical models and statistical info **a.iv.** Aware of and able to use various resources, including modern technology	**a.** demonstrate appropriate mastery of knowledge, techniques, skills, and modern tools of the discipline**;** **b.** demonstrate ability to apply current knowledge and adept to emerging applications of math, science, engineering and technology**;** **d.** demonstrate ability to apply creativity in the design of systems, components or processes appropriate to program objectives; **f.** demonstrate ability to identify, analyze, and solve technical problems; **g-h.**demonstrate ability to communicate effectively in writing and orally**;** **l.** demonstrate commitment to quality, timeliness, and continuous improvement; **m.** demonstrate ability to ….utilize computer applications effectively; **o.** demonstrate an ability to manage projects, industrial systems, lead personnel effect.	Individual project research Individual project design Written individual & team plan(s); Individual and Team Portfolio(s); website(s); Individual and team presentations; Industrial panel evaluation Project evaluation

V. Student Learning Outcomes	Embedded NIU General Ed Goals	Embedded NAIT/ABET Learning Standards	Assessments/Rubrics
4.To demonstrate effective use of project management techniques and tools in the management of a technical project: **a. planning; b. initiation** **c. execution; d. evaluation** **e. termination; f. problem-solving; g. MS Project;** **h. finance procedures; i. procurement procedures;** **j. scheduling; k. MACE process & procedures** **5. To integrate mathematics, the sciences, English, management, technical and technological knowledge and skills to accomplish team and project objectives:** **(a) Design, (b) Build a vehicle to technical specification that will run; (c) Solve technical problems encountered; (d) test and evaluate the vehicle to technical specifications**	**a.** cultivate habits of writing, speaking, quantitative reasoning for continued learning: **a.iii**.perform basic computations, display facility with use of quantitative reasoning in forming concepts for analysis & in problem solving, and interpret mathematical models & statistical information; **iv.** Aware of & able to use various resources, including technology; **b.** develop an ability to use modes of inquiry across a variety of disciplines in the physical sciences, mathematics: **iii.** demonstrate ability to use scientific methods, theories to science phenomena; **c.** develops understanding of discipline interrelatedness, applying that knowledge to an understanding of important problems & issues.	**a.** demonstrate an appropriate mastery of the knowledge, techniques, skills, and modern tools of the discipline**;** **b.** demonstrate ability to apply current knowledge, adapt to emerging applications of math, science, engineering and technology**;** **d.** demonstrate an ability to apply creativity in the design of systems, components or processes appropriate to program objectives; **f.** demonstrate an ability to identify, analyze, and solve technical problems; **g-h.**demonstrate an ability to communicate effectively in writing and orally**;** **l.** demonstrate a commitment to quality, timeliness, and continuous improvement; **m.** demonstrate an ability to ….utilize computer applications effectively; **o.** demonstrate an ability to manage projects; **p.** demonstrate an ability to manage and manipulate industrial systems; **q.** demonstrate knowledge, strategies and/or techniques of how to lead personnel and teams effectively	Project plan Project execution & completion to technical standards Project termination with lessons learned Project evaluation by industrial panel Project presentation Project portfolio and website MS Project 2003 test and application in project planning, execution, termination, assessment and evaluation MACE-Project assessment (Plan compliance & adjustments) Logs Project Design Project building using technical Processes Project testing procedures Testing data collection Testing evaluation process Project Metric process
6. Prepare the team for project and team work by: **a. developing a team operations manual** **b. developing peer and team assessment system** **c. creating team organization & process** **d. developing team project plan** **7. Demonstrate effective team performance (hopefully MC team) while:** **a. engaged in a community service project; plan execute, report relevance.** **b. engaged in the initiation, planning, execution and termination of a technical project** **c. engaged in course L. activities**	**d.** develops social responsibility & preparation for citizenship through service and an appreciation of cultural diversity.	**e.** demonstrate ability to function effectively on teams**;** **j.** demonstrate ability to understand professional, ethical, social responsibilities**;** **k.** demonstrate respect for diversity, knowledge of contemporary professional, societal and global issues;	Team Operations Manual; Team Plan Team presentation; portfolios; website; Team peer,, team, & conflict assessments/logs; Industrial panel evaluation; Formal paper ;5 minute learning papers Team success rubric

VI. Topics, Class Schedule & Due Dates

Week/Date	**Topics**	**Date**	**Topics/Lab Act.**	**Assignment Due Dates**
1 Course Intro	9:30 Writing Center Requirements (Jacky) 9: 45Career Project Intro and Requirements (Norwood) 10:00 Team Selection/Scheduling 10:30 Course Intro 11:30 Legacy Group Use of Planner & The Nature of Multitasking Project Research Assignment **Schedule Writing Center NOW!!!!**	**Teaming Team Assess.**	Team Skills Bank Finalize Teams & Schedules Plan Team Service Project Project Research Review	**Due 1/20 Writing Center Appointments Project Research Bring Planner Community Service Art. & Plan Due1/20 4:00pm**
2 Text 1-4, 19	TEXT Highlights	**Teaming *210 sched.**	Project Design Lab	**Writing Center Appts. Due 1/25 Text Proj. 1-4, 19, 20 due 1/25 Industry Case ID due 1/25 Final Project Research due 1/27**
3 Teaming Text 18 & HB	Project Teams: hidden agendas, teamwork, effective teams & members, member roles & responsibilities – Peer Assessment **(Team Packet Required)**	**Research Design *210 sched.**	Project Design Lab	**Text Project 18, 21 due 2/1 Project Design due 2/4 Friday**
4 Teaming Text 20	Project Teams: conflict resolution, decision-making, teams in trouble, empowerment, trust, recognition **(Team Packet Required)**	**Teaming**	Team Manual Lab	**Lit. Research Table due 2/8 Career Project due 2/11**
5 Project Planning Text 11,6	Project Planning - Section I Rubric & TEXT Vision, Mission, Intro, Purpose, Scope, Objectives, Deliverables, Charter, Org. Charts, Stakeholder Analysis, Com Interface, Project Review, Change Plan **[Paper due]**	**Teaming**	Research, Case, Paper, Career Validation Activity – Group Process Team Manual Lab	**Industry Case due 2/15 Text Proj. 6, 8, 11, 16 due 2/15 Team Manual due 2/14**
6 Project Planning Text 13,	Project Planning - Section II Rubric & TEXT Business & Proj. Success Factors, SWOT Analysis, Project Constraints, Risk Analysis, Contingency Plans & Trade Offs, Statement of Work, Goals, Work Break-down Structure	**Project Planning *210 sched.**	Project Planning – Section II Lab	**Community Leadership Project and Articles due 2/25 Friday Paper due 2/21**
7 Project Planning	Section II Rubric & TEXT (Continued) Life Cycle, Productivity Plan, Quality Standards & Metrics, Project Monitoring, Assessment, Control and Evaluation, Linear Charts, Resource Plan/Budget MS Project - PM Software	**Software Workshop *210 sched.**	MS Project-PM Software	**Text Proj. 5,9, 12, 13, 14, 15 due 3/1**
8 Project Planning	Section III Rubric & TEXT Environmental/Safety Plan, Security Plan, Documentation/Configuration Mgmt. Plan, Project Divestment & Termination Plan	**Software Workshop *210 sched.**	MS Project-PM software	**Individual Plans due 3/11 Software Test due by 3/9**
	BREAK	**3/17**	**BREAK**	
9	Project Development & Teamwork	**3/24**	Project Development & Teamwork **[Logs]**	**Individual Portfolios due 3/22 Team Plans due 3/25**
10	Project Development & Teamwork	**3/31**	Project Development & Teamwork **[Logs]**	**Individual Portfolios due**
11	Project Development & Teamwork	**4/7**	Project Development & Teamwork**[Logs]**	
12	Project Development & Teamwork	**4/14**	Project Development & Teamwork**[Logs]**	
13	Project Development & Teamwork	**4/21**	Project Development & Teamwork **[Logs]**	
14	Project Development & Teamwork	**4/28**	Project Testing and Initial Assessment	**Proj. Test./Assess due 4/28-29**
15	**[Final Project Assessment & Grade]** [Peer Assessments Executed & Due] [Team Member Participation Determined]	**5/5**	**[Team Presentations 8:30am-12:30] [Team Portfolio/Website/Success due]**	**Team ProjectAssessment due 5/3 Team Pres./Port./Web. Due 5/5**
16 May_____ Finals Week		**5/12**	**Final Exam: TBD If needed to confirm competencies**	

VII. Course Requirements:

Individual Course Requirements:	**Points:**	**Team Course Requirements:**	**Points:**	**Grading:**
Text Project (broken into sections for due dates)	7			
Project Research	5			
Project Design	5			**Benchmark=98-100**
Literature/Internet Research Tables A & B	7	Team Manual	5	**A=93-100**
(Projs/Tms/Lead/Int'l Tms/MCTms/MCLd)		Community/Leadership Service Project /Arts	3	**B=85-92**
Career Project	5	Team Project Plan	5	**C=77-84**
Ind. Case Study	5	Team Project & Assessment (Final Exam)	7	**D=70-76**
Paper	7	*Peer Assessment Process /Team Success	5	**F= Below 70**
Midterm: Individual Project Plan	7	*Team Member Participation (Ind. Pts.3)		
Software Workshop/Test	5	Team Presentation & Success (Final Exam)	5	
*Team Participation Awarded by Team	3	(Ind. Pres. Impacts Profs. Points)		
Project Feedback Logs	1	Team Project Portfolio & Website	5	
Individual Portfolio & Assessment Process	3			
(Final Exam)		Final II: TBD if needed to confirm competencies.		
Professors Overall Assessment & Ind. Pres.	5			
Total Individual Points Possible	**65**	**Total Team Points Possible**	**35**	
Professor's Privilege	**See Note #2**			

VIII. Cheating:
Cheating is unacceptable; refer to the NIU Judicial Code; any students cheating will be dismissed from the course immediately.

IX. Professor's Role: This course involves the professor and graduate assistant in a variety of roles; the professor will provide a scenario, objectives, and standards and then guide, coach, and direct most of the time, however, there will be some lectures. This course is performance based, thus, there are usually no traditional objective tests. There are subjective tests in the form of the 5-10 minute learning papers, essays and the text project to determine concept attainment. Students will construct knowledge/skills while engaged in learning & performances. Assessment will occur as learning occurs.

X. Professor's Notes:
1. Unexcused absences could result in one lettergrade reduction each **(7pts)**. Class/lab/ team meetings/work sessions attendance mandatory. **Tardiness unacceptable. Door may close when class begins; late admittance may not be permitted according to prof.'s prerogative.** Unexcused class/team tardies, **1 point per 30 minutes IF you are allowed in and door is open; don't count on door being open.**
2. The professor reserves the right to determine the final grade in the case of a student who does not perform on the team.
3. Unexcused late projects/assignments will result in point reduction, **2 points per day late**.
4. Dress code: no hats in lab **ever**! Professional dress **required** for final presentation.
5. Monitor language in class/lab at all times; good grammar and communication skills expected at all times; professional language expected.
6. Students are required to see the Writing Center tutor for all written assignments until approved otherwise, at least 2 visits per assignment; 3 visits required for paper. **(1)** Meet once to design paper, then meet with draft in hand **(2-3)** twice and rewrite. An appointment to plan the written assignment with no draft for review would still require 2 other visits for all other assignments.
7. Unannounced individual portfolio checks throughout course; 5 point penalties for portfolios not up to date each time.
8. No cell phone ringers in the class or lab at any time; **5 points deducted for in-class interruptions**. See professor exception approval.
9.Students can not pass class without ALL assignments turned in. Student will receive an I (incomplete) until all assignments are turned in. Penalties may occur for grades of Incomplete.

XI. Support Services Available for Students: The NIU writing center provides tutoring for writing. Students in this class are required to use that service for all written assignments; each writing assignment requires two visits/critiques and rewrites before assignment can be handed in to professor. Tutor signatures and forms are required to be turned in with written products. Math and science tutors available in College. NIU accommodations for any student with special needs. See professor individually.

XII. References on reference in Founders Library on NIU main campus: Kerzner. Smith. Project Management & Teamwork. McGrawHill. Angus, Gundersen, Cultinane. Planning, Performing and Control- ling Projects. Prentice Hall. 2000; Dinsmore. Human Factors in Project Management. Dinsmore. Project Management. Thomsett. The Little Black Book of Project Management. AMACOM; Kerzner, Thamhain. Projet Management Operating Guidelines. VNR.; Rosenau. Successful Project Management. VNR.; Weiss, Wysocki. 5-Phase Project Management. Addison Wesley; Cleland, Gareis. Global Project Management Handbook. McGrawHill.; Miller. Visual Project Planning & Scheduling; Barkley, Saylor. Customer Driven Project Management. McGrawHill; Lewis. Mastering Project Management. McGrawHill; Forseberg, Mooz, Goterman. Visualizing Project Management. Wiley; Dinsmore. Winning in Businesss With Enterprise Project Management. AMACOM; Graham, Englund. Creating an Environment for Successfu Projects. JoseyBass;Gray, Larson. Project Management. McGraw Hill. 2000.; Cleland. Project Management. McGrawHill; Meredith, Mantel. Project Management. Wiley. 2000; Lewis. Team-based Project Management. AMACOM; Kliem, Ludin. Project Management Practitioner's Handbook. AMACOM; Kerzner. In Search of Excellence in Project Management. ITP VNR; Ruskin, Estes. What Every Engineer Should Know About Project Management. Dekker; Buttrick. The Project Workout. FT Pitman; Rowenau. Project Management for Engineers. Ran Nostrand Reinhold; Cleland. Field Guide to Project Management. ITP VNR; Briner, Geddings, Hastings. Project Leadership. Van Nostrand Reinhold; Rosenau. Successful Project Mgmt. Wi.

XIII. Course Requirements Explanation
Individual Requirements:

Text Project: Read the entire text and answer the take-home questions. You will engage in a group process and then participate in a non-traditional test on this content to ensure concept attainment. ***Individual and Group Process.***

Technical Research and Design

Project Research: Research project assigned. More information about this research will be provided in class. However, it will entail an Internet/Literature search, possibly interviewing technical experts, local or suburban vendors or manufacturers, or other professors, and/or researching specific technicalities. It will also include research of all properties of materials, mathematics, and scientific principles, theories involved in the technical aspects of the project. Use research information to design the project. ***See Rubric. Individual and Group Process.***

Project Design: Students will design and prepare visuals and working drawings, schematics, etc. for the project using prior design and computer aided drafting or mechanical drawing knowledge and skills. ***See Rubric. Individual and group process.***

Real World Validation – Culminating Paper

Literature/Internet Research A: Search the literature (Internet) on project management, project teams, and project leadership; identify 45 quality sources, 15 each about **(a)**industrial projects**,(b)** project teams, and **(c)**project leadership. Develop a literature/source review **Table** summarizing what the literature/sources revealed. Topics of focus should be the**(1.)**problems, issues, concerns, **(PICs)** difficulties that arise on projects or for the teams and leaders and **(2.)**success strategies that have worked for projects, project teams or leaders in resolving the problems/issues. There must be 45 sources; these must be from major recognized journals or books on the topics. You may, however, include up to five non-traditional sources, e.g. Internet sources from industrial groups, project teams, etc. Sources must show depth in content; short "briefs" are not acceptable. **Copy** all sources if not books on **diskette** or **CD** rather than hardcopies. ***See Table Format and Rubric. Group Process-Be prepared to discuss; thus, if no hardcopies available for reference, you need to know the material well.*** ****Create tables that are categorized, numbered and reveal indepth information with solutions. May use for your paper.**

Literature A + B = Total Table (See Rubric)

Literature/Internet Research B: Also, research **(a)**international projects, **(b)**multicultural teams, and **(c)**international project leadership with a multicultural team; identify 15 (5 for each topic) Internet and/or literature sources that discuss **(1.)**problems, issues and **(2.)** best practices, benefits, successes of multicultural/international projects, teams, and project or team leadership. Summarize the information learned by organizing it into a T**able** identifying the source author, title, main points on problems, issues, and benefits and your comments. ***See Rubric. Individual/Group Process-Be prepared to discuss; thus, your if no hardcopies available for your reference, you need to know the material well.*** ****Create tables that are categorized, numbered and reveal indepth information with solutions. May use for paper.**

Industrial Case Study: Identify a company that will allow you to visit and interview an industrial project team. Interview a **project leader or manager** and **at least three project team members** *or 2 project leaders and 2 project team members*. **(1.)**Ask them to identify all problems, issues, concerns, **(PICs)** or difficulties encountered on the project, about the project, team., and project leadership. Have them explain in detail; **(2.)**then, also ask them what strategies are successful for projects, teams, and project leaders. Create a table of questions and responses and present what was learned as "real-time" research. ***See Rubric and Format. Individual and Group Process.*** **Incorporate the results into your paper.**

Formal Paper: Meet with WC tutor to organize paper. Develop a paper about projects, teams and project leadership; develop the issues and solutions in greater depth; draw conclusions and describe effective project management, effective project teams, and effective project leadership. What strategies, techniques, processes should be used to have a more successful project, team, or leader/leadership process? End with very specific recommenddations to guide your project team on each of the 3 primary topics. Then include a section on how international projects and multi-cultural teams differ, what additional concerns, problems, and issues occur when operating internationally with diverse cultures. Make recommendations for successful international projects and on how to be a more effective leader of multicultural teams. Sixty (60) sources required (45 + 15). These 60 sources **may or may not** be the same ones that you identified for the literature review table. ****Incorporate the results of industrial case study** into your paper as well. Use the **APA** writing style manual. Identify all sources **in the paper's text** and in References Cited using the APA style format. Writing skills are seriously graded on this product. ***See Writing Rubric, Paper Outline & Rubric. Individual and Group Process.***

Project Planning - Midterm Exam

MS Project Software Workshops/Test: Participate in the software workshop(s). Complete **Test.** MS Project documents required in PLANs.

MidTerm - Individual Project Plan: Use the outline & rubric provided as a guide, develop a detailed project plan. The plan will not be accepted unless every category is complete. Reference the text, other sources in the library or through the Internet, or sources listed on the course syllabus. All members of a team must have their plan in and graded before they will be approved to work on the "team" plan. This is another product where writing will be graded seriously. This is technical writing which is different than the narrative or prose approach used in the above assignments. ***See Plan Outline/Rubric.I/GP***

Logs: Periodically you will be asked to complete a log about how you feel the team and project are progressing. These must be completed and turned in.

Individual Component of Team Presentation: Speaking, non-verbal communication, presentation skills, content, grammar/wording visuals, style, organization, use of technology, humor, etc. graded individually during team presentation. Remember that each team member must demonstrate speaking and presentation skills. Teams could acquire the full point value, but individuals will be assessed on their individual performance as well. Professional dress required. ***See Presentation Outline/Rubric.***

Team Participation Points Awarded by Team: Each team member will be allocated points for team participation. Teams will award points to team members for quality of work and participation. Points will serve to "grade" participation. Dr. Scarborough validates that the distribution is appropriate for participation observed. Full participation is expected of each team member. Tardiness or absences from team meetings, class, labs are not acceptable behaviors. You will be asked to explain to the class openly why you are late or absent and points will be deducted. ***See Rubric. Individual/ Group Process.***

Employment

Career Project: a) Interview Mr. Norwood, the CEET Career Planning & Placement specialist, on the assigned topic; engage in group process. Document findings as assigned (TBD); **b)**Research jobs/positions/career in project management; Bring in copies of 10 position announcements which review expectations, required knowledge, skills, background for those seeking to become project managers, team leaders, or project team members; **c)** Design and develop a resume to use to seek such a position, but also make it applicable for other industrial technology, management, engineering, etc. positions. Have it reviewed and approved by Mr. Norwood for inclusion into personal 496 portfolio. Mr. Norwood will grade this project.

Individual Portfolio: This portfolio has a somewhat different focus. Although it may contain everything in the team portfolio for job-seeking purposes, it must also include all individual work, including Writing Center Reviews and multiple iterations of particular products. Use Course Requirements list on Course Syllabus (above) and Team Portfolio Rubric to determine what is to be included. You will participate in assessment activities throughout the semester, including analysis and reflections about what your strengths and weaknesses are and what you **can do to improve or continue well. The portfolio must be professionally presented, e.g. typed tabs, etc. Final Reflections at end of semester/questions to answer..**

Team Requirements:

Community Service Project: Each team has to research, determine, plan and execute an 8 hour service project. Research one article per team member on the benefits of community service and leadership by local industrial personnel. Generate a brief team plan of what, who, when and where. It should include a goal, operational objectives, expected outcomes and benefit to group served. Prepare an **informal presentation** about what you learned, how you felt and your potential future in community service. ***See Rubric***. ***Individual/ Group Process.***

Team Process

Team Manual: The team manual includes all team operational policies and procedures, the team problem-solving process, communication strategy and procedures, decision-making process, authority linear charts, team roles and responsibilities, etc. The team is to provide evidence that it operated using the team manual as its structure, process and guiding document. ***See Outline/Rubric. Group Process.***

Included in the Team Manual are the following critical components, plus others: See Team Manual Outline/Rubric. **Group Process.**

Team Skills Bank: Each team will prepare a team skills bank that identifies all individual talent, skills, knowledge that each team member brings to the project. This bank will be used to organize the team, project, work packages and deliverables. **Group Process.**

Team/Project Charter, Logo, Company & Project Organizational Chart: Each team will create an official charter, identify a team logo, and design an organizational chart for their company and their team/project. **Group Process.**

Team Assessment Inventory(ies): Each team will design and develop a peer and team status inventory to use to monitor team process; they will also adapt a conflict management inventory to use to monitor the team conflict resolution process. The information gained from using these inventories will be used to build and strengthen the team and to identify and solve team issues or problems. Growth and development should be an outcome of using these instruments. Each team must produce a report of results from using these instruments and assessment process twice during the project period.

Team Project Plan: Each team must write/develop a team plan; however, the team may not begin on the team plan until all individual plans are graded and returned. The plan outline is the same as the individual plan. Each team must produce a plan for the technical project assigned and use the plan as a compliance document to monitor, assess, control and evaluate the project. ***See Outline/Rubric***. ***Group Proc.***

Final Exam

Team Project: Each team will be responsible for designing and developing a technical project. You will generate technical standards to achieve and the metrics to use to measure the standards achievement level. The project must "function" or "work" to be accepted for a grade. It must meet the standards at the level described in the team plan using the metrics predetermined. Every team member must have major project role and responsibilities. The team must complete the project by the deadline on the syllabus. The project is the "vehicle" providing evidence of high performance teaming and project management as well as the knowledge, skills, and abilities from academic career and work experience. ***Team derived/Professor approved- predetermined -Standards/metrics = grading Rubric. Group Process.***

Team Portfolio: The portfolio is the culminating documentation of all project and team work. It must include information on every topic listed in the outline/rubric. It should include pictures, mechanical drawings, etc. and be professionally produced in hard-copy form. An operator's and maintenance manual must be developed and included for the technical project (product). ***See Rubric. Group Process.***

Team Website: Each team is to design and produce a team web-site which will serve as an electronic portfolio. This website/ portfolio must be presented during the team presentation. The outline is the same as the hard-copy portfolio. A CD must be included in the hard copy of the team portfolio. ***See Rubric. Group Process.***

Final Team Presentation: Each team is to professionally present their project, portfolio/website and information for each category on the presentation outline. This is a formal presentation where communication skills, presentation skills, etc. will be graded. Professional dress required. An industrial panel will observe the presentations. ***Presentation CD must be in Portfolio. See Outline/Rubric.***

Course Requirements Check Off

Individual Contributions:

Benchmark=98-100 (This means that you set the standard for others.)

A=93-100 points
B=92.9-85 points
C=84.9-77 points
D=76.9-70 points
F=Below 70 points

_____ (7) Text Project

_____ (5) Project Research

_____ (5) Project Design

_____ (7) Literature/Internet Research Tables A & B

_____ (5) Career Project

_____ (5) Industrial Case Study

_____ (7) Paper

_____ (7) Midterm: Individual Project Plan

_____ (5) Software Workshop/Test

_____ (3) *Team Participation Awarded by Team Members (confirmed by Professor)

_____ (1) Project Feedback Logs

_____ (3) Individual Portfolio & Assessment Process

_____ (5) Professor's Overall Assessment

_____ **(65) Total Individual Points Possible**

Note: To keep track of your progress, add the possible points of work to date; then figure the percentage, e.g.
Text (7) + P.Research (5) + P.Design (5)= 17
.93 x 17 = 15.81 = lowest possible score or point value to maintain an A (lowest A).

IF your goal is to be a **Benchmark Student,** where <u>your</u> work best exemplifies the course's highest standards…where you set the standard, then you must maintain no lower than 98% or ultimately 98 points for the course.

If a <u>team's</u> goal is to be a **Benchmark Team,** where the team best exemplifies the course's highest standards for teams…where the team sets the standard for other teams, then <u>**every team member**</u> in that team must maintain 98% or ultimately 98 points each for the course.

Team Contributions:

_____ (5) Team Manual

_____ (3) Community/Leadership Service Project/Articles

_____ (5) Team Project Plan

_____ (7) Team Project & Assessment (Final Exam)

_____ (5) *Peer Assessment Process/Team Success

_____ (5) *Team Member Participation

_____ (5) Team Presentation & Success (Final Exam)
*Individual Presentation (in Team Final Presentation)

_____ (5) Team Project Portfolio & Website

_____ **(35) Total Team Points Possible**

Technology 496 - Industrial Project Management

Prof: Dr. Scarborough **Grad. Asst: _____** **Ph:** 753-0210(Dr. Scarborough)/1570(GA) **Off.Hrs:** T12-3 **Email: _______**

I. Catalog Course Description: Industrial Project Management (3). Basic concepts, principles, and skills of project management. Designed to cover a variety of types of project management. Emphasis on computer tools and project management techniques. Analysis of case studies. Culminating project required.

II. Course Purpose & Objectives: To prepare project leaders and team members to formally initiate, execute and terminate industrial projects effectively. To integrate and apply knowledge, skills, and abilities acquired or extended during students' college careers (general education and major) and work experience to research, design, build and finalize a technical project within a team and formal project environment.

III. Required Text: <u>Project Management</u>. Cleland & Ireland, 2006 or latest edition. **Required: Date book/Calendar for scheduling and notes; Handout packet.**

IV. Pre-requisites: Tech 265-Mfg. Processes; Tech 302- Graphic Pres.& Comm.; Tech 395-Ind. Data Processing; **Senior Status**

Expected Computer Usage: CAD, MS Office, MS Project, CNC, industrial equipment, or other, depending upon semester/ team project. **Required Laboratory Team Project:** Changes each semester; each team will engage in a complex technical project with specific technical standards to achieve, e.g. Go-kart, 3-car passenger train, hovercraft, paddle wheel boat, personal transport vehicle etc. Research, design, assembly of electrical/mechanical systems, testing, modifications/finalization with formal documentation, formal team products and team requirements. See requirements section, handouts, and rubrics.

V. Course Requirements:

Individual Course Requirements:	**Points:**	**Team Course Requirements:**	**Points:**	**Grading:**
Text Project (broken into sections/due dates)	7	Team Operations Manual	5	Benchmark
Project Research	5	Community Leadership Service	3	A=98-100
Project Design	5	Project & Articles		
Literature/Internet Research Tables A & B	7	Team Project Plan	5	A=93-97
(Projs/Tms/Lead/Int'l/MCTms/MCLd)		Team Project & Assessment	7	B=92-85
Career Project	5	(Final Exam)		C= 84-77
Individual Case Study	5	*Peer Assessment Process	5	D=76-70
Paper	7	& Team Success Assessment		F=69-below
Midterm: Individual Project Plan	7	*Team Member Participation		
Software Workshop/Test	5	(Ind. Pts. 3/5)		
*Team Participation Awarded by Team	3	Team Presentation & Success	5	
Project Feedback Logs	1	(Final Exam)		
Individual Portfolio & Assessment Process	3	Team Project Portfolio & Website	5	
(Final Exam)				
Professor's Overall Assessment		Final Exam II: TBD		
Ind.Presentation within Team Presentation.	5	(if needed to confirm competencies)		
Total Individual Points Possible	**65**	**Total Team Points Possible**	**35**	
Professor's Privilege	See Note #2			

VI. Student Learning Outcomes

Student Learning Outcomes	Embedded NIU General Ed Goals	Embedded NAIT/ABET Learning Standards	Assessments/Rubrics
1A/B. Identify and describe major problems, issues, concerns, and solutions (PICS) that relate to (a) projects, (b) project management, (c) project teams, and (d) project leaders, also for (e) Int'l projects and (f) multicultural (MC) teams. **2. Identify and describe best practices for managing projects and leading teams; include Int'l teams and MC teams.**	**a.i.** communicate clearly in English, demonstrating ability to comprehend, analyze and interrogate critically; **ii.** communicate in a manner that unites theory, criticism, practice in speaking & listening; **a.iv.** Aware of and able to use various resources, including modern technology	**g.**demonstrate an ability to communicate effectively in writing**;** **h.** demonstrate an ability to communicate effectively orally; **m.** demonstrate an ability to ….utilize computer applications effectively**;** **k.** demonstrates a respect for diversity and knowledge of contemporary professional, societal and global issues.	Text Project or Text Test Research- Literature/Internet; Case study; Group analysis process Formal paper; group analysis 1-5 minute learning papers; Individual portfolios; Team Project portfolio/website; Individual/team presentations Team participation & Peer Assessment Team Operating Manual Individual and Team Project Plan Community leadership project
3a. Demonstrate effective project management of a technical project using appropriate PM techniques, tools, and processes: **a. planning,** **b. initiation,** **c. execution,** **d. termination** **e. evaluation** **f. problem solving** **g. leadership** **h. financial management** **i. procurement management** **j. scheduling** **k. MACE process and procedures** **3b. Design, develop, and deliver:** **e. executive team presentation** **f. team portfolio** **g. team website** **4. To integrate mathematics, the sciences, English, management, technical, technological systems knowledge and skills to accomplish individual and team project objectives: (a) Design, (b) Build a vehicle to technical specification that will operate; (c) Solve technical problems encountered; (d) test and evaluate the vehicle for meeting technical specifications and standards**	**a.** cultivate habits of writing, speaking, quantitative reasoning for continued learning: **a.i.** communicate clearly in English, demonstrating ability to comprehend, analyze and interrogate critically; **ii.** communicate in a manner that unites theory, criticism, practice in speaking & listening; **a.iii**.perform basic computations, display facility with use of quantitative reasoning in forming concepts for analysis and in problem solving, and interpret mathematical models and statistical info **a.iv.** Aware of and able to use various resources, including modern technology **b.** develop an ability to use modes of inquiry across a variety of disciplines in the physical sciences, mathematics: **b.iii.** demonstrate ability to use scientific methods, theories to science phenomena; **c.** develops understanding of discipline interrelatedness, applying that knowledge to an understanding of important problems & issues.	**a.** demonstrate appropriate mastery of knowledge, techniques, skills, and modern tools of the discipline**;** **b.** demonstrate ability to apply current knowledge and adept to emerging applications of math, science, engineering and technology**;** **d.** demonstrate ability to apply creativity in the design of systems, components or processes appropriate to program objectives; **f.** demonstrate ability to identify, analyze, and solve technical problems; **g-h.** demonstrate ability to communicate effectively in writing and orally**;** **l.** demonstrate commitment to quality, timeliness, and continuous improvement; **m.** demonstrate ability to ….utilize computer applications effectively; **o.** demonstrate an ability to manage projects, industrial systems, lead personnel effect. **p.** demonstrate an ability to manage and manipulate industrial systems; **q.** demonstrate knowledge, strategies and/or techniques of how to lead personnel and teams effectively	Individual & Team project research Individual & Team project design Written individual & team plan(s); Technical project prototype product produced to technical standards and specifications using technical processes Project testing & evaluation against established standards and specifications using formal evaluation tools and procedures MS Project 2003 test and application in project planning, execution, termination, assessment and evaluation MACE-Project assessment (Plan compliance & adjustments) Individual & Team Logs Individual and Team Portfolio(s); website(s); Individual and team presentations; Industrial panel evaluation Project termination with lessons learned Project evaluation by industrial panel
5. Develop the team for project and team work by: **a. developing a team operations manual** **b. developing peer and team assessment system** **c. creating team organization & process** **d. developing team project plan** **6. Demonstrate effective team performance (hopefully MC team) while:** **a. engaged in a community service project; plan, execute, & report relevance.** **b. engaged in the initiation, planning, execution and termination of a technical project** **c. engaged in course Team & Project activities**	**d.** develops social responsibility & preparation for citizenship through service and an appreciation of cultural diversity.	**e.** demonstrate ability to function effectively on teams**;** **j.** demonstrate ability to understand profess-ional, ethical, social responsibilities**;** **k.** demonstrate respect for diversity, knowledge of contemporary professional, societal and global issues;	Team Operations Manual; Team Plan Team presentation; portfolios; website; Team peer,, team, & conflict assessments/logs; Industrial panel evaluation; Formal paper ;5 minute learning papers Team success rubric

VII. Topics, Class Schedule & Due Dates

Week/Date	Topics	Date	Topics/Lab Act.	Assignment Due Dates
1 Course Intro	9:30 Writing Center Requirements (Jacky) 9: 45Career Project Intro and Requirements (Norwood) 10:00 Team Selection/Scheduling 10:30 Course Intro 11:30 Legacy Group Use of Planner & The Nature of Multitasking Project Research Assignment **Schedule Writing Center NOW!!!!**	**Teaming Team Assess.**	Team Skills Bank Finalize Teams & Schedules Plan Team Service Project Project Research Review	**Due 1/20 Writing Center Appointments Project Research Bring Planner Community Service Art. & Plan Due1/20 4:00pm**
2 Text 1-4, 19	TEXT Highlights	**Teaming *210 sched.**	Project Design Lab	**Writing Center Appts. Due 1/25 Text Proj. 1-4, 19, 20 due 1/25 Industry Case ID due 1/25 Final Project Research due 1/27**
3 Teaming Text 18 & HB	Project Teams: hidden agendas, teamwork, effective teams & members, member roles & responsibilities – Peer Assessment **(Team Packet Required)**	**Research Design *210 sched.**	Project Design Lab	**Text Project 18, 21 due 2/1 Project Design due 2/4 Friday**
4 Teaming Text 20	Project Teams: conflict resolution, decision-making, teams in trouble, empowerment, trust, recognition **(Team Packet Required)**	**Teaming**	Team Manual Lab	**Lit. Research Table due 2/8 Career Project due 2/11**
5 Project Planning Text 11,6	Project Planning - Section I Rubric & TEXT Vision, Mission, Intro, Purpose, Scope, Objectives, Deliverables, Charter, Org. Charts, Stakeholder Analysis, Com Interface, Project Review, Change Plan **[Paper due]**	**Teaming**	Research, Case, Paper, Career Validation Activity – Group Process Team Manual Lab	**Industry Case due 2/15 Text Proj. 6, 8, 11, 16 due 2/15 Team Manual due 2/14**
6 Project Planning Text 13,	Project Planning - Section II Rubric & TEXT Business & Proj. Success Factors, SWOT Analysis, Project Constraints, Risk Analysis, Contingency Plans & Trade Offs, Statement of Work, Goals, Work Break-down Structure	**Project Planning *210 sched.**	Project Planning – Section II Lab	**Community Leadership Project and Articles due 2/25 Friday Paper due 2/21**
7 Project Planning	Section II Rubric & TEXT (Continued) Life Cycle, Productivity Plan, Quality Standards & Metrics, Project Monitoring, Assessment, Control and Evaluation, Linear Charts, Resource Plan/Budget MS Project - PM Software	**Software Workshop *210 sched.**	MS Project-PM Software	**Text Proj. 5,9, 12, 13, 14, 15 due 3/1**
8 Project Planning	Section III Rubric & TEXT Environmental/Safety Plan, Security Plan, Documentation/Configuration Mgmt. Plan, Project Divestment & Termination Plan	**Software Workshop *210 sched.**	MS Project-PM software	**Individual Plans due 3/11 Software Test due by 3/9**
	BREAK	**3/17**	**BREAK**	
9	Project Development & Teamwork	**3/24**	Project Development & Teamwork **[Logs]**	**Individual Portfolios due 3/22 Team Plans due 3/25**
10	Project Development & Teamwork	**3/31**	Project Development & Teamwork **[Logs]**	**Individual Portfolios due**
11	Project Development & Teamwork	**4/7**	Project Development & Teamwork**[Logs]**	
12	Project Development & Teamwork	**4/14**	Project Development & Teamwork**[Logs]**	
13	Project Development & Teamwork	**4/21**	Project Development & Teamwork **[Logs]**	
14	Project Development & Teamwork	**4/28**	Project Testing and Initial Assessment	**Proj. Test./Assess due 4/28-29**
15	**[Final Project Assessment & Grade]** [Peer Assessments Executed & Due] [Team Member Participation Determined]	**5/5**	**[Team Presentations 8:30am-12:30] [Team Portfolio/Website/Success due]**	**Team ProjectAssessment due 5/3 Team Pres./Port./Web. Due 5/5**
16 May_____ Finals Week		**5/12**	**Final Exam: TBD If needed to confirm competencies**	

VIII. Course Requirements Explanation -- Individual Requirements:

Technical Research and Design

Project Research: Research project assigned. More information about this research will be provided in class. However, it will entail an Internet/Literature search, possibly interviewing technical experts, local or suburban vendors or manufacturers, or other professors, and/or researching specific technicalities. It will also include research of all properties of materials, mathematics, and scientific principles, theories involved in the technical aspects of the project. Use research information to design the project. ***See Rubric. Individual and Group Process.***

Project Design: Students will design and prepare visuals and working drawings, schematics, etc. for the project using prior design and computer aided drafting or mechanical drawing knowledge and skills. ***See Rubric. Individual and group process.***

Real World Validation – Culminating Paper

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Literature A + B = Total Table (See Rubric)

Literature/Internet Research B: Also, research **(a)**international projects, **(b)**multicultural teams, and **(c)**international project leadership with a multicultural team; identify 15 (5 for each topic) Internet and/or literature sources that discuss **(1.)**problems, issues and **(2.)** best practices, benefits, successes of multicultural/international projects, teams, and project or team leadership. Summarize the information learned by organizing it into a T**able** identifying the source author, title, main points on problems, issues, and benefits and your comments. ***See Rubric. Individual/Group Process-Be prepared to discuss; thus, your if no hardcopies available for your reference, you need to know the material well.*** ****Create tables that are categorized, numbered and reveal in-depth information with solutions. May use for paper.**

Industrial Case Study: Identify a company that will allow you to visit and interview an industrial project team. Interview a **project leader or manager** and **at least three project team members** *or 2 project leaders and 2 project team members*. **(1.)**Ask them to identify all problems, issues, concerns, **(PICs)** or difficulties encountered on the project, about the project, team., and project leadership. Have them explain in detail; **(2.)**then, also ask them what strategies are successful for projects, teams, and project leaders. Create a table of questions and responses and present what was learned as "real-time" research. ***See Rubric and Format. Individual and Group Process.*** **Incorporate the results into your paper.**

Formal Paper: Meet with WC tutor to organize paper. Develop a paper about projects, teams and project leadership; develop the issues and solutions in greater depth; draw conclusions and describe effective project management, effective project teams, and effective project leadership. What strategies, techniques, processes should be used to have a more successful project, team, or leader/leadership process? End with very specific recommendations to guide your project team on each of the 3 primary topics. Then include a section on how international projects and multi-cultural teams differ, what additional concerns, problems, and issues occur when operating internationally with diverse cultures. Make recommendations for successful international projects and on how to be a more effective leader of multicultural teams. Sixty (60) sources required (45 + 15). These 60 sources **may or may not** be the same ones that you identified for the literature review table. ****Incorporate the results of industrial case study** into your paper as well. Use the **APA** writing style manual. Identify all sources **in the paper's text** and in References Cited using the APA style format. Writing skills are seriously graded on this product. ***See Writing Rubric, Paper Outline & Rubric. Individual and Group Process.***

Project Planning - Midterm Exam

MS Project Software Workshops/Test: Participate in the software workshop(s). Complete **Test.** MS Project documents required in PLANs.

Midterm - Individual Project Plan: Use the outline & rubric provided as a guide, develop a detailed project plan. The plan will not be accepted unless every category is complete. Reference the text, other sources in the library or through the Internet, or sources listed on the course syllabus. All members of a team must have their plan in and graded before they will be approved to work on the "team" plan. This is another product where writing will be graded seriously. This is technical writing which is different than the narrative or prose approach used in the above assignments. ***See Plan Outline/Rubric. I/GP***

Employment

Career Project: a) Interview Mr. Norwood, the CEET Career Planning & Placement specialist, on the assigned topic; engage in group process. Document findings as assigned (TBD); **b)**Research jobs/positions/career in project management; Bring in copies of 10 position announcements which review expectations, required knowledge, skills, background for those seeking to become project managers, team leaders, or project team members; **c)** Design and develop a resume to use to seek such a position, but also make it applicable for other industrial technology, management, engineering, etc. positions. Have it reviewed and approved by Mr. Norwood for inclusion into personal 496 portfolio. Mr. Norwood will grade this project.

Individual Portfolio: This portfolio has a somewhat different focus. Although it may contain everything in the team portfolio for job-seeking purposes, it must also include all individual work, including Writing Center Reviews and multiple iterations of particular products. Use Course Requirements list on Course Syllabus (above) and Team Portfolio Rubric to determine what is to be included. You will participate in assessment activities throughout the semester, including analysis and reflections about what your strengths and weaknesses are and what you **can do to improve or continue well. The portfolio must be professionally presented, e.g. typed tabs, etc. Final Reflections at end of semester/questions to answer.**

Team Requirements:

Community Service Project: Each team has to research, determine, plan and execute an 8 hour service project. Research one article per team member on the benefits of community service and leadership by local industrial personnel. Generate a brief team plan of what, who, when and where. It should include a goal, operational objectives, expected outcomes and benefit to group served. Prepare an **informal presentation** about what you learned, how you felt and your potential future in community service. ***See Rubric*. *Individual/ Group Process***

Team Process

Team Manual: The team manual includes all team operational policies and procedures, the team problem-solving process, communication strategy and procedures, decision-making process, authority linear charts, team roles and responsibilities, etc. The team is to provide evidence that it operated using the team manual as its structure, process and guiding document. ***See Outline/Rubric. Group Process.***

Included in the Team Manual are the following critical components, plus others: See Team Manual Outline/Rubric. **Group Process.**

> **Team Skills Bank**: Each team will prepare a team skills bank that identifies all individual talent, skills, knowledge that each team member brings to the project. This bank will be used to organize the team, project, work packages and deliverables. **Group Process.**
>
> **Team/Project Charter, Logo, Company & Project Organizational Chart:** Each team will create an official charter, identify a team logo, and design an organizational chart for their company and their team/project. **Group Process.**
>
> **Team Assessment Inventory(ies):** Each team will design and develop a peer and team status inventory to use to monitor team process; they will also adapt a conflict management inventory to use to monitor the team conflict resolution process. The information gained from using these inventories will be used to build and strengthen the team and to identify and solve team issues or problems. Growth and development should be an outcome of using these instruments. Each team must produce a report of results from using these instruments and assessment process twice during the project period.

Team Project Plan: Each team must write/develop a team plan; however, the team may not begin on the team plan until all individual plans are graded and returned. The plan outline is the same as the individual plan. Each team must produce a plan for the technical project assigned and use the plan as a compliance document to monitor, assess, control and evaluate the project. ***See Outline/Rubric*. *Group Proc.***

Logs: Periodically you will be asked to complete a log about how you feel the team and project are progressing. Completed and turn in.

Individual Component of Team Presentation: Speaking, non-verbal communication, presentation skills, content, grammar/wording visuals, style, organization, use of technology, humor, etc. graded individually during team presentation. Remember that each team member must demonstrate speaking and presentation skills. Teams could acquire the full point value, but individuals will be assessed on their individual performance as well. Professional dress required. ***See Presentation Outline/Rubric.***

Team Participation Points Awarded by Team: Each team member will be allocated points for team participation. Teams will award points to team members for quality of work and participation. Points will serve to “grade” participation. Dr. Scarborough validates that the distribution is appropriate for participation observed. Full participation is expected of each team member. Tardiness or absences from team meetings, class, labs are not acceptable behaviors. You will be asked to explain to the class openly why you are late or absent and points will be deducted. ***See Rubric*. *Individual/ Group Process***

Final Exam

Team Project: Each team will be responsible for designing and developing a technical project. You will generate technical standards to achieve and the metrics to use to measure the standards achievement level. The project must "function" or "work" to be accepted for a grade. It must meet the standards at the level described in the team plan using the metrics predetermined. Every team member must have major project role and responsibilities. The team must complete the project by the deadline on the syllabus. The project is the "vehicle" providing evidence of high performance teaming and project management as well as the knowledge, skills, and abilities from academic career and work experience. ***Team derived/Professor approved- predetermined -Standards/metrics = grading Rubric. Group Process.***

Team Portfolio: The portfolio is the culminating documentation of all project and team work. It must include information on every topic listed in the outline/rubric. It should include pictures, mechanical drawings, etc. and be professionally produced in hard-copy form. An operator's and maintenance manual must be developed and included for the technical project (product). ***See Rubric. Group Process.***

Team Website: Each team is to design and produce a team web-site which will serve as an electronic portfolio. This website/ portfolio must be presented during the team presentation. The outline is the same as the hard-copy portfolio. A CD must be included in the hard copy of the team portfolio. ***See Rubric. Group Process.***

Final Team Presentation: Each team is to professionally present their project, portfolio/website and information for each category on the presentation outline. This is a formal presentation where communication skills, presentation skills, etc. will be graded. Professional dress required. An industrial panel will observe the presentations. ***Presentation CD must be in Portfolio. See Outline/Rubric.***

VIII. Cheating:
Cheating is unacceptable; refer to the NIU Judicial Code; any students cheating will be dismissed from the course immediately.

IX. Academic Misconduct: Refer to the NIU Judicial Code; Immediate and appropriate actions will occur for any students behaving inappropriately, e.g. cheating, will be dismissed from the course immediately.

X. Professor's Role: This course involves the professor and graduate assistant in a variety of roles; the professor will provide a scenario, objectives, and standards and then guide, coach, and direct most of the time, however, there will be some lectures. This course is performance based, thus, there are usually no traditional objective tests. There are subjective tests in the form of the 5-10 minute learning papers, essays and the text project to determine concept attainment. Students will construct knowledge/skills while engaged in learning & performances. Assessment will occur as learning occurs.

XI. Professor's Notes:

1. Unexcused absences could result in one letter grade reduction each **(7pts)**. Class/lab/ team meetings/work sessions attendance mandatory. **Tardiness unacceptable. Door may close when class begins; late admittance may not be permitted according to prof.'s prerogative.** Unexcused class/team tardies, **1 point per 30 minutes IF you are allowed in and door is open; don't count on door being open.**
2. The professor reserves the right to determine the final grade in the case of a student who does not perform on the team.
3. Unexcused late projects/assignments will result in point reduction, **2 points per day late**.
4. Dress code: no hats in lab **ever**! Professional dress **required** for final presentation.
5. Monitor language in class/lab at all times; good grammar and communication skills expected at all times; professional language expected.
6. Students are required to see the Writing Center tutor for all written assignments until approved otherwise, at least 2 visits per assignment; 3 visits required for paper. **(1)** Meet once to design paper, then meet with draft in hand **(2-3)** twice and rewrite. An appointment to plan the written assignment with no draft for review would still require 2 other visits for all other assignments.
7. Unannounced individual portfolio checks throughout course; 5 point penalties for portfolios not up to date each time.
8. No cell phone ringers in the class or lab at any time; **5 points deducted for in-class interruptions**. See professor exception approval.
9. **Students can not pass class without ALL assignments turned in. Student will receive an I (incomplete) until all assignments are turned in. Penalties may occur for grades of Incomplete.**

XII. Support Services Available for Students: The NIU writing center provides tutoring for writing. Students in this class are required to use that service for all written assignments; each writing assignment requires two visits/critiques and rewrites before assignment can be handed in to professor. Tutor signatures and forms are required to be turned in with written products. Math and science tutors available in College. NIU accommodations for any student with special needs. See professor individually.

XIII. References on reference in Founders Library on NIU main campus: **Kerzner. Smith. Project Management & Teamwork. McGrawHill. Angus, Gundersen, Cultinane. Planning, Performing and Control- ling Projects. Prentice Hall. 2000; Dinsmore. Human Factors in Project Management. Dinsmore. Project Management. Thomsett. The Little Black Book of Project Management. AMACOM; Kerzner, Thamhain. Project Management Operating Guidelines. VNR.; Rosenau. Successful Project Management. VNR.; Weiss, Wysocki. 5-Phase Project Management. Addison Wesley; Cleland, Gareis. Global Project Management Handbook. McGrawHill.; Miller. Visual Project Planning & Scheduling; Barkley, Saylor. Customer Driven Project Management. McGrawHill; Lewis. Mastering Project Management. McGrawHill; Forseberg, Mooz, Goterman. Visualizing Project Management. Wiley; Dinsmore. Winning in Business With Enterprise Project Management. AMACOM; Graham, Englund. Creating an Environment for Successful Projects. JoseyBass; Gray, Larson. Project Management. McGraw Hill. 2000.; Cleland. Project Management. McGrawHill; Meredith, Mantel. Project Management. Wiley. 2000; Lewis. Team-based Project Management. AMACOM; Kliem, Ludin. Project Management Practitioner's Handbook. AMACOM; Kerzner. In Search of Excellence in Project Management. ITP VNR; Ruskin, Estes. What Every Engineer Should Know About Project Management. Dekker; Buttrick. The Project Workout. FT Pitman; Rowenau. Project Management for Engineers. Ran Nostrand Reinhold; Cleland. Field Guide to Project Management. ITP VNR; Briner, Geddings, Hastings. Project Leadership. Van Nostrand Reinhold; Rosenau. Successful Project Mgmt. Wi.**

XIV. Course Requirements Check Off

Individual Contributions: **Benchmark=98-100 (This means that you set the standard for others.)**

______ (7) Text Project

______ (5) Project Research

______ (5) Project Design

______ (7) Literature/Internet Research Tables A & B

______ (5) Career Project

______ (5) Industrial Case Study

______ (7) Paper

______ (7) Midterm: Individual Project Plan

______ (5) Software Workshop/Test

______ (1) Project Feedback Logs

______ (5) Professor's Overall Assessment

______ **(65) Total Individual Points Possible**

A=93-100 points
B=92.9-85 points
C=84.9-77 points
D=76.9-70 points
F=Below 70 points

Note: To keep track of your progress, add the possible points of work to date; then figure the percentage, e.g.
Text (7)+P.Research(5)+P.Design(5)=17
.93 x 17 = 15.81 = lowest possible score or point value to maintain an A(lowest A).

IF your goal is to be a **Benchmark Student,** where your work best exemplifies the(confirmed by Professor) course's highest standards …where you set the standard, then you must maintain no lower than 98% or ultimately 98 points for the course.

Team Contributions:

______ (5) Team Manual

______ (3) Community/Leadership Service Project/Articles

______ (5) Team Project Plan

______ (7) Team Project & Assessment (Final Exam)

______ (5) *Peer Assessment Process/Team Success

______ (5) *Team Member Participation

______ (5) Team Presentation & Success (Final Exam)
*Individual Presentation (in Team Final Presentation)

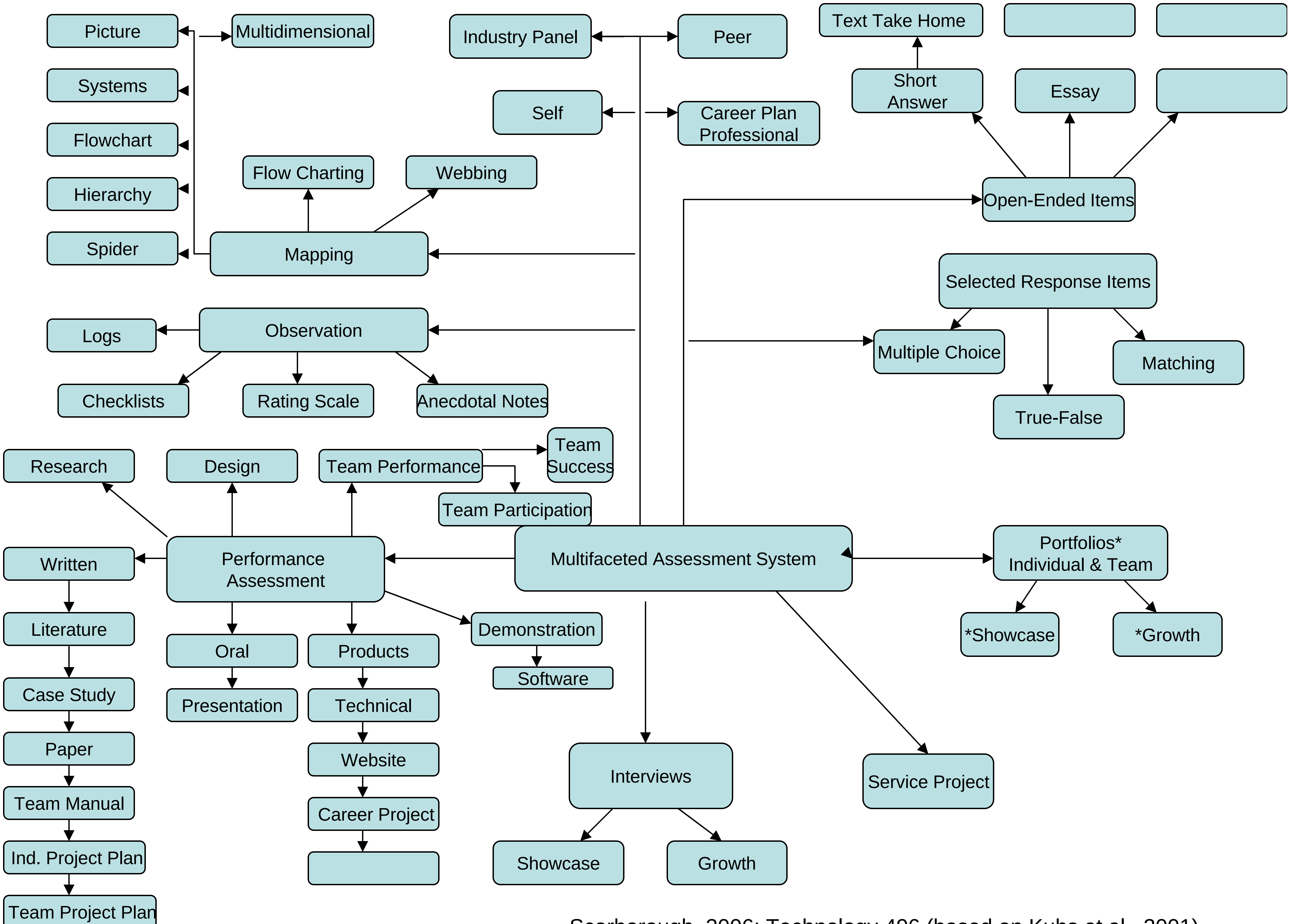
______ (5) Team Project Portfolio & Website

______ **(35) Total Team Points Possible**

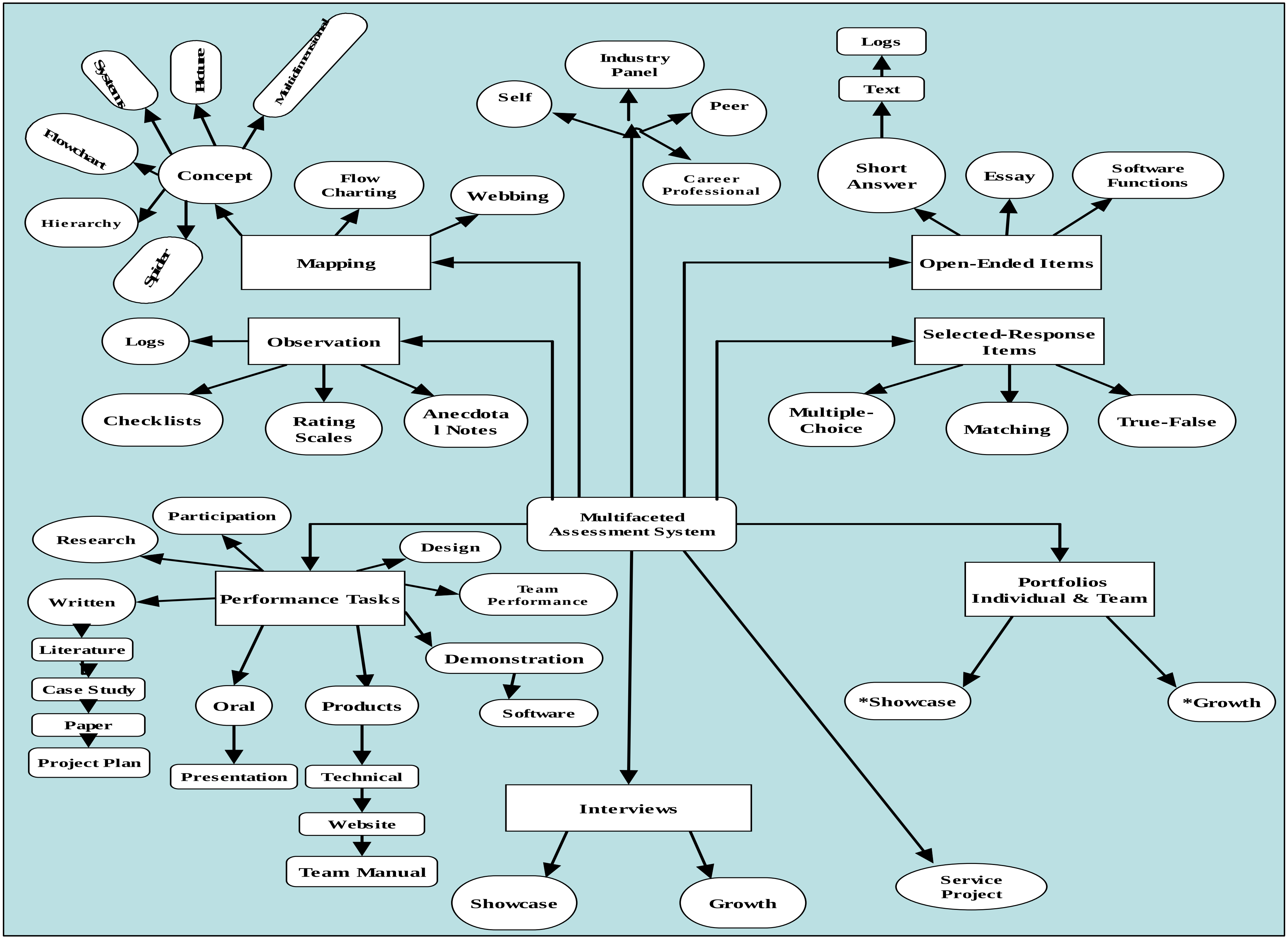
IF a team's goal is to be a **Benchmark** Team**,** where the team best exemplifies the course's highest standards for teams… where the team sets the standard for other teams, then **every team Member** in that team must maintain **98**% or ultimately 98 points each for the course.

Course Title and Number

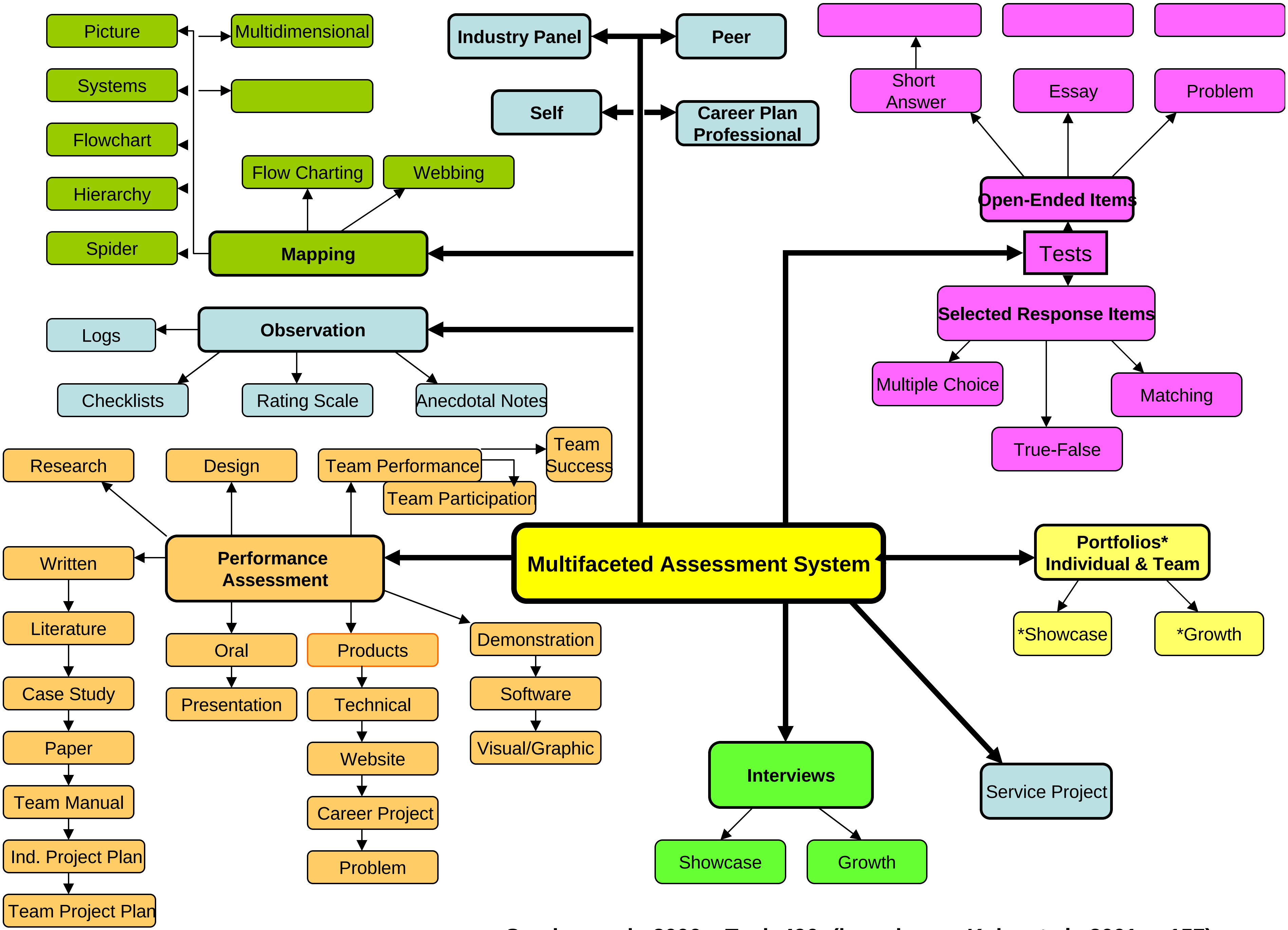
Student Learning Objectives and Outcomes				Assessments: Test Alignments Midterm & Final
	Student Learning Objectives/Outcomes-Major	**Student Learning Objectives - Minor**		**Corresponding Tests and Test Items**
1		**a**		
		b		
		c		
		d		
2		**a**		
		b		
		c		
		d		
3		**a**		
		b		
		c		
		d		
4		**a**		
		b		
		c		
		d		
5		**a**		
		b		
		c		
		d		
6		**a**		
		b		
		c		
		d		
7		**a**		
		b		
		c		
		d		
8		**a**		
		b		
		c		
		d		
9		**a**		
		b		
		c		
		d		
10		**a**		
		b		
		c		
		d		
11				
12				



Scarborough, 2006; Technology 496 (based on Kuhs et al., 2001)



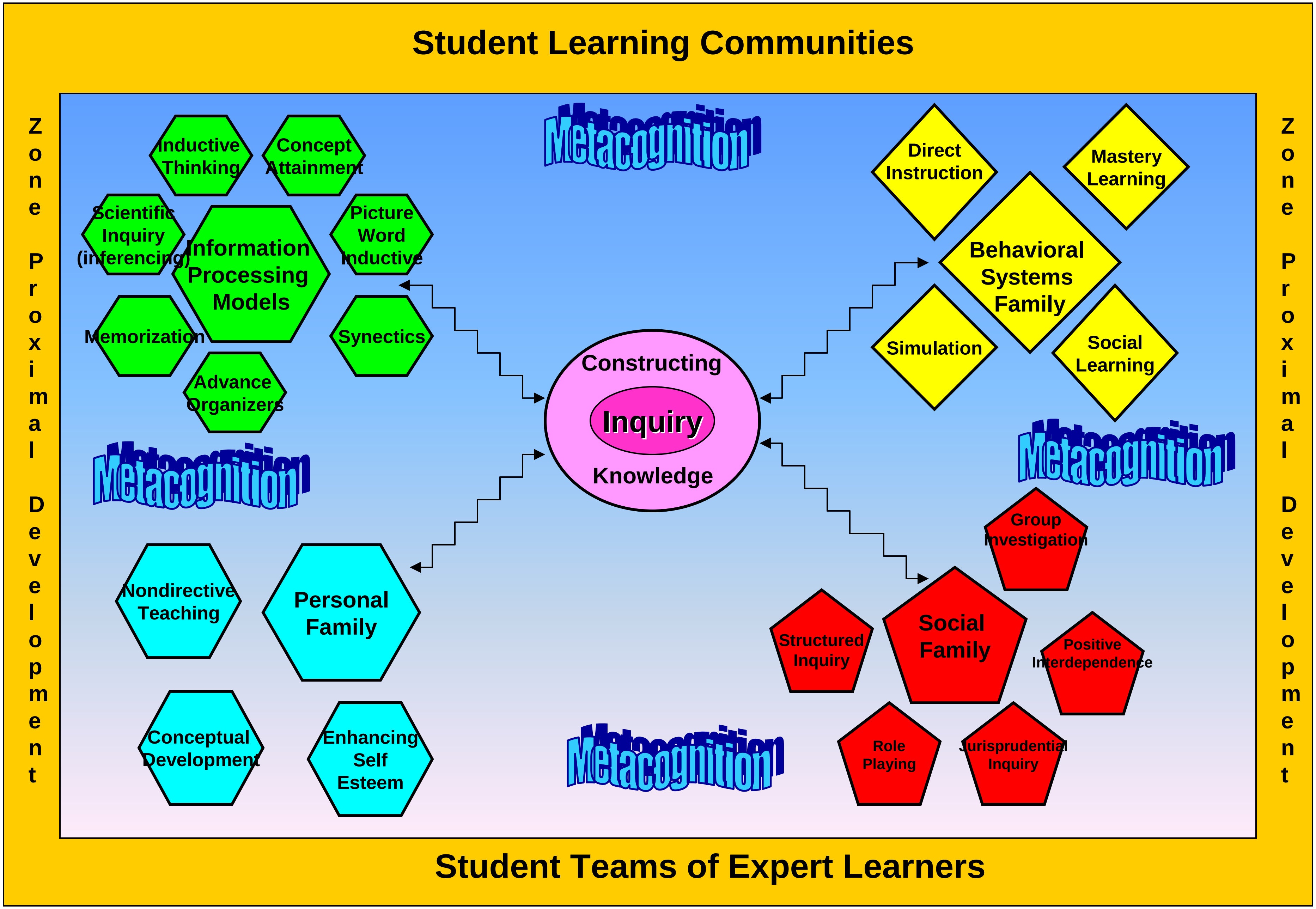
Scarborough, 2006; Technology 496 (based on Kuhs et al., 2001)



Scarborough, 2006 – Tech 496 -(based upon Kuhs et al., 2001, p.157)

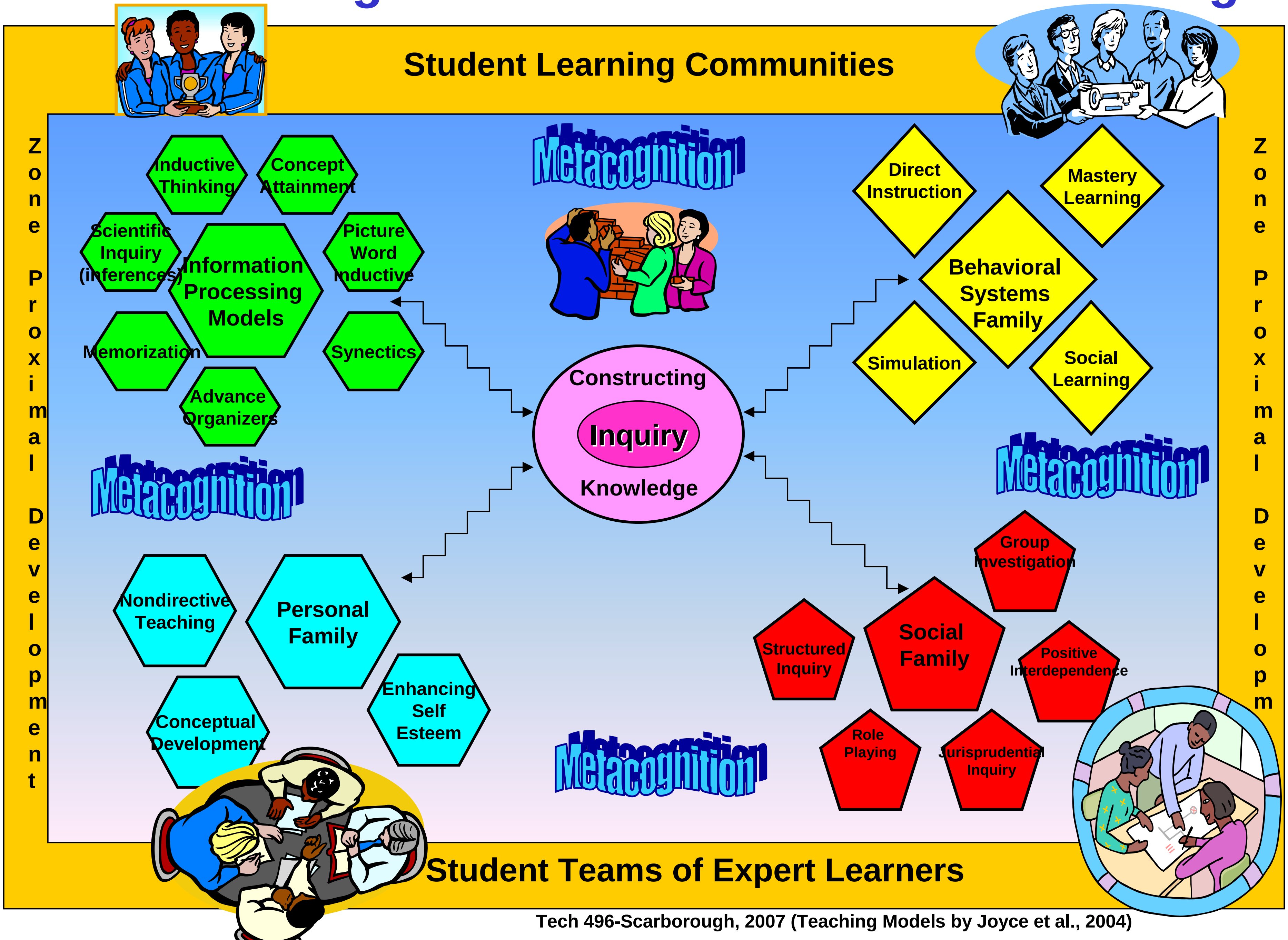
Analysis Table for Assessments – Bloom's Taxonomy- Cognitive Dimension						
Assessments	**Knowledge**	**Comprehension**	**Application**	**Analyze**	**Synthesize**	**Evaluate**
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Pre-Assessment						
Midterm						
Quizes 1,2,3						
Final						
Performance Task 1 **Performance Task 2** **Performance Task 3** **Performance Task 3**						
Research						
Homework						
Lab or Field Experiments						
<u>Miscellaneous:</u> **Individual Assessments** **Web Page** **Group/Team Assessments** **Group Discussion** **Round Table Discussion** **Oral Presentation** **Visual Presentation** **Technical Project** **Case Study**						

The Learning Environment: Models of Teaching



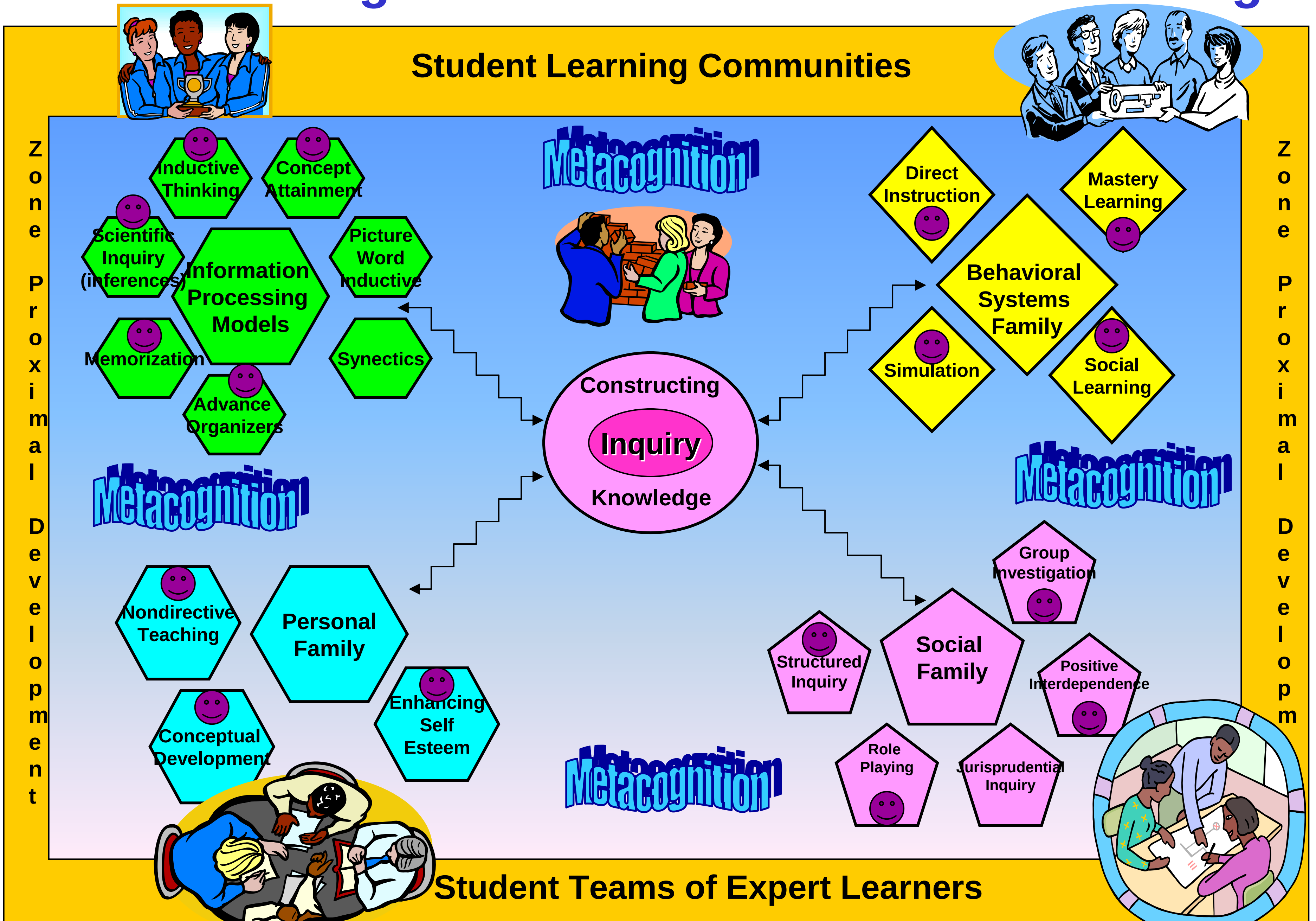
Scarborough, 2007 (Teaching Models by Joyce et al., 2004)

The Learning Environment: Models of Teaching



Tech 496-Scarborough, 2007 (Teaching Models by Joyce et al., 2004)

The Learning Environment: Models of Teaching



Tech 496-Scarborough, 2007 (Teaching Models by Joyce et al., 2004)

Foundation: Concepts that Apply to Learning

Concepts – Chapter 1, p. 3	Description	Meaning for Me and My Practice	Changes I will make based upon my understanding of this concept?	Where will these changes "show up" in the teaching and learning experiences throughout the semester?
Constructivism, p. 12				
Metacognition, p. 14				
Scaffolding, p. 14				
Zone of Proximal Development, p. 16 **(optimal mismatches with tasks given to students)**				
Roles of Expert Performance, p. 20				

I. Models of Teaching – Information Processing Models

Models	Description	Strengths	Weaknesses	How I can use this model-describe
Inductive thinking, Ch. 3, p. 41 **(classification-oriented)**				
Concept Attainment, Ch. 4, p. 59 **(includes concept formation)**				
The Picture-Word Inductive Model Ch. 5, p. 77				
Scientific Inquiry, Ch. 6, p. 101 **Inquiry Training**				
Mnemonics, Ch.7, p.131 **(memory assists)**				
Synectics, Ch. 8, p. 155 **(includes metaphoric activity)**				
Advance Organizers, Ch. 9, p. 187				

II. Models of Teaching – Social Models

Model	Description	Strengths	Weaknesses	How I can use this model-describe
Partners in Learning, Ch. 10, p. 205				
Positive Interdependence, p. 211				
Structured Inquiry, p. 221				
Group Investigation p. 213, 14-227				
Role Playing, Ch.11, p. 229				
Jurisprudential Inquiry, Ch. 11, p. 249				

III. Models of Teaching – Personal Family

Model	Description	Strengths	Weaknesses	How I can use this model-describe
Nondirective teaching, ch. 12, p. 271				
Enhancing Self-esteem, ch. 13, p. 283				
Conceptual Development Ch. 13, p. 290				

IV. Models of Teaching – Behavioral Models

Model	Description	Strengths	Weaknesses	How I can use this model-describe
Mastery Learning, ch. 14, p. 303 Programmed Schedule, p. 310 Programmed Schedule, 3.11 (task performance reinforcement)				
Direct Instruction, Ch. 15, p. 313				
Simulation, Ch. 16, p. 323 Training and Self-Training				
Social Learning, Ch.14 (includes training & self-training)				

Bloom's Learning Taxonomy – Analysis Chart for Assessments

Assessment	Knowledge	Comprehension	Application	Analyze	Synthesize	Evaluate
	Remember	Understand	Apply	Analyze	Evaluate	Create
Midterm						
Final						
Performance						
Performance						
Performance						

VI. Course Topics, Class Schedule & Due Dates

Week Obj	TM TS	LS	Topics/Lab Activities & Due Dates	TM TS	LS	Topics/Lab Activities & Due Dates
1 8/28						
2 9/4						
3 9/11						
4 9/18						
5 9/25						
6 10/2						
7 10/9						
8-10/16 MT						
9 10/23						
10 10/30						
11 11/6						
12 11/13						
13 11/20						11/23 THANKSGIVING
14 11/27						
15 12/4						
16-2/11 FE						

VI. Course Topics, Class Schedule & Due Dates

Week Obj	TM TS	LS	Topics/Lab Activities Due Dates	TM TS	LS	Topics/Lab Activities Due Dates	TM TS	LS	Topics/Lab Activities Due Dates
1 8/28									
2 9/4									
3 9/11									
4 9/18									
5 9/25									
6 10/2									
7 10/9									
8 10/16 MT									
9 10/23									
10 10/30									
11 11/6									
12 11/13									
13 11/20									11/23 THANKSGIVING
14 11/27									
15 12/4									
16-2/11 FE									

Teaching Learning Calendar/Content Analysis Legend

<u>Teaching Models</u>
(Joyce, Weil, Calhoun, 2004)

IT – inductive thinking
CA - concept attainment
PWIM – picture word induction model
ScI – scientific inquiry
M – mneumonics
S – synectics
AO – advance organizers
Partners
CL-I – cooperative learning-informal
CL-F – cooperative learning-formal
SI – structured inquiry
GI – group investigation
RP – role playing
JI – jurisprudential inquiry
NT – nondirective teaching
ES – enhancing self-esteem
ML – mastery learning
PS – programmed schedule
DI – direct instruction
S - simulation

<u>Teaching Styles</u>
(Mosston & Ashworth, 1990)

C – command (A)
P – practice (B)
R – reciprocal (C)
SC – self check (D)
I – inclusion (E)
GD – guided discovery (F)
CD – convergent discovery (G)
DP – divergent production (H)
LD – learner designed (I)
LI – learner initiated)J)
ST – self teach (K)

<u>Teaching Styles</u>
(Grasha, 1996)
E – expert
FA – formal authority
PM – personal model
F - facilitator
D – delegator

<u>Kolb's Learning Styles</u>
(Kolb, 1984)

CE – concrete experience
RO – reflective observation
AC – abstract conceptualization
AE – active experimentation

<u>Bloom (1956)</u>
K-R – knowledge or remember
C-U – comprehension or understanding
Ap - application or apply
An - analyze
S-E - synthesize or evaluate
E-C - evaluate or create

<u>Dale's Cone of Learning</u>
(Dale, 1969)
P – passive (listening only)
I – intermediate
(participating in discussion)
A – active (doing)

Excerpts from Questionnaire – Teaching Styles and Models Worksheet

36. My professor exhibited the following styles of instruction throughout the semester. Select ALL that apply.

(a) ___ teacher makes all decisions on what, where, when, and how learning takes place; is the expert; strives for precision, synchronization, and uniformity; determines what is taught and how it will be evaluated

(b) ___ students are given a number of tasks to practice; students can ask questions; teacher moves around and gives feedback

(c) ___ students provide feedback to each other; one student performs while another provides feedback; teacher designs forms to guide the observations; socialization is inherent in this style; students develop feedback skills

(d)___ feedback is provided by you as the individual learner to yourself; other events providing external feedback facilitate your ability to do this; professor helps you become a better evaluator, increasing your self-esteem about working independently

(e) ___ we select our own level of performance and alter it according to my self-evaluation; the professor determined the tasks and defined the levels of difficulty

(f) ___ professor leads students to discover concept by answering a series of questions; professor determines concepts and best sequences for guidance; friendly environment with time to think built into the learning opportunity; professor traces a series of questions leading to the answer

(g) ___ professor presents question; students use logical and critical thinking to discover solutions; students determine questions to ask rather than the professor; professors respect for the process and do not interfere

(h) ___ professor encourages students to find multiple solutions to given problems; professor selects the subject and designs the problem – there is no one right answer; professor responds to student process rather than the value of a solution or answer

(i) ___ the student and professor selects the content to be learned; the student designs, develops, and performs the series of tasks **<u>and/or</u>** students select the activity, design the experiences, perform the tasks; professors assists/consults with the evaluation of tasks

(j) ___ students take full responsibility for the learning process; they do not consult with the professor

Teaching Models

The professor lectures information and connections; I listen and take notes, if I choose (Lecture)

The professor focuses or presents content, then breaks the class into student groups to discuss the content, then engages in summarizing and clarifying the content as a group. (Reciprocal)

The professor focuses or presents content, then assigns individual but short term projects using the content or information, e.g., problem to solve, design project, analysis. (Reciprocal Performance)

The professor focuses or presents content, breaks the class into student groups to discuss the content, and then engages in a short term group project using the content or information, e.g. problems to solve, design project, analysis. (Reciprocal Performance)

Lessons are broken down in components; as individual students master each component, they are tested; when they pass the test, they go on to the next component. (Mastery learning)

The professor uses visual charts, displays a wide range of graphic organizers or other visuals to better organize and present information; to show relationships between concepts and principles; and to increase understanding about the application of foundation concepts or principles. (Graphic Organizers)

When presenting content, the professor uses examples that are and are not representative of the concept or principle. Students compare the examples and match those that represent the concept or not; gradually as more examples that are and are not representative are reviewed, the group reaches consensus of what examples directly represent the content and come away with greater understanding. (Concept Attainment)

Lessons require that we combine concepts and analyze the relationships of concepts; we then engage in solving problems (conceptualization)

During the lessons, the professor asks us to identify and enumerate information related to concepts as they are demonstrated, grouping concepts into categories with common attributes. (Concept Formation)

We learn information on concepts through the act of classification, gathering and classifying information to build and test hypotheses; they engage in experiments and the results of experiments are used to develop hypothesis generalizations about the situation, idea, or problem. (move from information to problem) (Inductive Thinking)

We are presented with generalizations and examples and engage in trying to glean or identify the individual situation or idea that is embedded (move from problem to why something happens) (Deductive Thinking)

We are presented with a problem and then create questions to be used to solve the problem. We engage in a process of investigation and explanation of the phenomena. (Inquiry)

We engage in a formally organized court case to present information and arguments about the ingrained issues. (Jurisprudential)

We are instructed on each component of the content and all must be successful on that content before the professor moves on with new or more complex content (Direct Instruction)

Lessons break skills down into components and sequences of action; each person learns the skill step by step the same way (Training)

Lessons begin by focusing on a current situation; analogies are used to define the characteristics of the situation; analogies continue, using other graduated analogies until it appears to have no relationship to the origin; the lesson then uses the final description of the analogy to compare to the original situation (Synectics)

Lessons engage us in the development of physical skills, such as welding (Psycomotor)

The professor uses metaphors to make content more familiar (Metaphorical)

Lessons focus on personal development, free expression of ideas and feelings, furthering your self-understanding (Non-directive)

We explore problems through actions developing problem solving skills; we participate and/or observe (Role Play)

Bloom's Taxonomy of Learning

a. the learning of basic knowledge requiring me to list, name, identify, show, define, recognize, recall, state, visualize, state facts, concepts, theories, principles, information?

b. the comprehension or greater understanding of knowledge through activities that required me to summarize, explain, interpret, describe, compare, paraphrase, differentiate, demonstrate, classify, or contrast facts, information, concepts, theories, principles?

c. the application or opportunity to “do” or “perform” using knowledge, requiring me to solve problems, illustrate, calculate, use, interpret, relate, manipulate, apply, modify facts, concepts, theories, information, or data?

d. analytical activities that required me to analyze and organize facts, data, and information; deduce patterns and trends; and contrast, compare, and distinguish differences or similarities, and then discuss solutions, directions and plan or devise actions?

e. the synthesis and evaluation of facts, information, data, situations, problems, and furthermore require me to argue rationally, support or justify a method, solution, action, choice of formula, theory, concept, principle or result in the need to propose a hypothesis, following with the design of an experiment, product, process, technique, and/or make judgments that had to be critiqued and defended and finalized into reports, summaries, or papers.

f. the design, discovery, invention, development, creation, research, or transformation of knowledge into products, processes, techniques, models, methods, strategies, etc., using design and development, research, experimentation, and/or development knowledge, techniques, procedures, and tools?

Degrees of Active or Engaged Learning

a. The professor assumes the entire responsibility for delivering the course content. He/she lectures all information we are expected to learn. The text is used as a reference. Lectures reflect text content.

b. The professor assumes the entire responsibility for delivering the course content in combination with assigned readings from the textbook. The lectures and text content provide all the information we are expected to learn. Most lectures correlate directly or are duplication of text content.

c. Students are assigned reading from the text to gain basic course content; my professor explains difficult content from the text, then adds lectures on some important or critical content that is not covered in the text, thus expanding or deepening understanding and ability to use the information from the text.

d. Students are responsible for some of their own learning. For example, once a concept, or principle is explained by the professor and we have used the text for basic learning, as a source or reference, we then have to perform research on content ourselves to deepen our understanding of the concept and its application possibilities. We have to bring the information back to class to share with the professor and class. Student activities can vary from literature research, case studies, identifying additional sources of information (e.g. books, people, examples, demonstrations, etc.). Students are required to learn on their own or in small groups to deepen understanding or extend learning and understanding beyond that presented by the professor or established learning activities.

e. The professor assigns reading from the text, explains difficult content, and then provides content to deepen or extend the basic text content or to clarify or explain content not well understood. Students are responsible for some of their own learning, and we then engage in research to solidify understanding of the content. Ultimately, the professor then assigns projects that expand learning into the “doing” dimension where we used the content learned to solve a problem, develop a product, construct a theoretical model, use materials, processes, and knowledge to create, etc.

f. Students are responsible for a great deal of their own learning. After working with us in a variety of ways, many of them highly engaging students to learn important knowledge and skills where the professor is more of a learning coach, direction setter, source of validation, someone who models an inquiry driven process of learning, with a strong focus on "how" and "why" processes, he/she provides the opportunity to engage in the creation of a solution to a identified need or problem applying the knowledge and skills learned earlier or throughout the learning processes throughout the semester.

Teaching Portfolio Assessment Chart, DATE - CITL Faculty Development Program

Portfolio Product (Artifact) Content **(See Sections of information following this summary)**	**Faculty Member**				**Faculty Member**		
Self Assessment Baseline: 1.____Student Questionnaires (f05 & f06) 1.____Professor completion(s) of Student Questionnaire (f05 &f06) 2.____Professor completions of Self Competency Questionnaire (Feb.06, May06, Dec.06) **3.____**Program Components Assessments (8) 4.____Standard Departmental Course Evaluations (f05 & f06) 4.____ Student Grades & End of Semester Grades (f05 & f06)							
5. Course Analysis: 5a1._Course Outline, Embedded Gen Ed, Content Priorities 5a2._Course Content Analysis by TM,TS, LS, Bl, Dale, etc. 5b. _ Instr. Design GAPS Analysis on- TM, TS, LS, B, D 5c. _ Instructional GAPS Summary 5d. _ ABET/TAC/NAIT SLO by Bloom's Analysis 5e. _ Course Content Schedule 5f._ Teaching Models+Cooperative Learning+Study Chart+TM graphic 5g._ Course Calendar by TM, TS, LS, B, D							
*****Student Learning Styles Inventory:*** (NOT REQUIRED)** Kolb (Extra professional effort on part of professors) Felder (Extra professional effort on part of professor)							
Multifaceted Assessment System: 5h.__ Multifacted Assessment Plan Graphic, showing course assessments 5i. __Test and Test Items by SLO Chart 5j.__Assessment Analysis by Bloom (Chart)							
6. Traditional Objective Tests:: _____Test Analysis (Midterm and Final Exam) _____Table of Specifications (not included) _____Test Item Bank (not included) 7.____New Midterm Exam 7.____New Final Exam 8. ___ Diagnostic Write Ups (MT & F)							
Performance Assessment & Rubrics: 7. _____ 3 Complex Performance Assessments with multiple tasks embedded 7._____3 Rubrics, one to score each Performance Assessment (And to be used with students to establish standards up front) 8._____ Diagnostic Write Ups (PA 1,2,3) *****_____ Copies of Students Rubrics (Hardcopies on file) 7._____ Electronic copies of tests and PAs & Rubrics **Other Assessments of Individual Choice: Yes for All**							
9. Student Centered Course Syllabus: _____All new components and check off list							
10. Professors' Research: **____ Completed Data Forms (including data on MT, F, PA1,2,3)** **____ Research Results Reports**							
12.___Teaching Portfolio Assessment Questionnaire **13___ Teaching Models Self Assessment** **14___ Teaching Styles Self Assessment** **15___ Student Learning Style Opportunities Assessment** **16___ Outcomes Achieved as Planned by Bloom & Dale Assessment**							
17. Manuscript to be submitted: **_____ Draft** **_____ Final Version to be submitted to journal (May, 2007)**							

Legend: √ = okay X = still needed ☺ = not due yet See Result

Initial Teaching Portfolio Assessment Process May 25, 2006 – CITL Professional Development Program

Portfolio Product (Artifact) Content	Description of my Knowledge, Skills, Abilities on Feb. 2, 2006	Description of my Knowledge, Skills, Abilities on May 25, 2006
Self Assessment Baseline: _____Student Questionnaire _____Professor completion of Student Questionnaire _____Professor Self Competency Questionnaire		
Course Analysis: _____GAPS Analysis on- TM, TS, LS, B, D _____ABET/TAC/NAIT SLO by Bloom's Analysis _____Course Calendar by TM, TS, LS, B, D _____Teaching Models + Cooperative Learning + Mapping Study Chart		
Student Centered Course Syllabus: _____All new components and check off list		
Portfolio Product (Artifact) Content **Multifaceted Assessment System:** _____Course Assessment Plan Chart showing course assessments _____Assessment Analysis by Bloom (Chart) **Traditional Objective Tests:** _____Test Analysis _____Table of Specifications _____Test Item Bank _____New Midterm Exam _____New Final Exam _____Test Items by SLO Chart **Performance Assessment & Rubrics:** _____ 3 Complex Performance Assessments with multiple tasks embedded _____3 Rubrics, one to score each Performance (Assessment and to be used with students to establish standards up front) **Other Assessments of Individual Choice: List and Describe Here** **1.____________________3.______________________** **2.____________________4.______________________**		

Initial Individual Portfolio Checklist of Products (Artifacts)

Note: For each component below, there is a rubric, checklist, worksheet, etc. from which to perform. Those are available for review in the Faculty Development Program section.

Self Assessment Baseline:
_____Student Questionnaire
_____Professor completion of Student Questionnaire(s)
_____Professor Self Competency Questionnaire(s)
_____Program Component Assessments
_____Standard Departmental Course Evaluations

Course Analysis:
_____GAPS Analysis on- TM, TS, LS, B, D + base worksheet
_____ABET/TAC/NAIT SLO by Bloom's Analysis
_____Course Calendar by TM, TS, LS, B, D
_____Teaching Models+Cooperative Learning+Mapping Study Chart

Student Centered Course Syllabus:
_____All new components and check off list

Multifaceted Assessment System:
_____Course Assessment Plan Chart showing course assessments
_____Assessment Analysis by Bloom (Chart)

Traditional Objective Tests:
_____Test Analysis
_____Table of Specifications
_____Test Item Bank
_____New Midterm Exam
_____New Final Exam
_____Test Items by SLO Chart

Performance Assessment & Rubrics:
_____3 Complex Performance Assessments
with multiple tasks embedded

_____3 Rubrics, one to score each Performance
Assessment and to be used with
students to establish standards
up front

Other Assessments of Individual Choice:
List and Describe Here:

1.________________________________ **2.**____________________________

3.________________________________ **4.** ____________________________

_____Teaching Portfolio Assessment Questionnaire

Point value for each item is from 1 to 4 – the same as the response labels. Maximum possible points = 100.

Competency Self Assessment
CEET Initiative on Teaching and Learning

Jule Dee Scarborough (2006)

Please respond to each question about the level of knowledge, skill, and confidence you feel you have.

1. Design and develop courses where student learning objectives and outcomes are clear and distinctly different.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

2. Designing and developing a logical and organized course where course syllabi are structured such that students fully understand what is to happen for the entire semester; where the syllabus is the course map for both myself (professor) and the students; where the syllabus provides all information about objectives, course content, timeline, course requirements, student learning assessments (tests, projects,etc.) grading structure and criteria, etc.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

3. Providing learning activities that align with the syllabus, course content identified in the syllabus; adhering to the timeline in the syllabus; and leading student learning without significant distractions or deviations unrelated to content where each lesson and learning activity are directly related and add value; where no unplanned, last minute, or major assignments not identified on the syllabus are imposed upon students unexpectedly.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

4. Designing a total student assessment system where there is a great variety of types of student learning assessment, tests, quizzes, case studies in industry, literature studies, research, papers or other writing assignments, projects, presentations, portfolios, etc.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

5. Designing student assessments that directly align and measure knowledge and/or skills itemized on course syllabi.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

6. Implementing a student learning assessment strategy throughout the course where feedback on all student assignments, or learning assessments is immediate (or reasonably timed, e.g. 2 weeks); in other words, students receive feedback from the professor on grades or scores for tests, projects, etc. that can be considered immediate in the university schedule context, e.g. 1-3 classes later.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

7. Designing and developing instruction using Bloom's Taxonomy of levels of learning where the upper levels of Bloom's are achieved many times throughout the course, e.g. levels-knowledge, comprehension, application, synthesis, analysis, and evaluation.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

8. Designing and developing student learning assessments, e.g. tests, performances, using Bloom's Taxonomy of levels of learning where the upper levels of Bloom's are achieved many times throughout the course, e.g. levels-knowledge, comprehension, application, synthesis, analysis, and evaluation.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

9. Developing a course using the "reversed design" process.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

10. Designing and developing traditional tests that directly measure what students are responsible for learning from professors and other sources or activities identified in the syllabi; where the items are an adequate sample of the content domain and the item types are appropriate to the purposes of the test; where the items require thinking at the upper levels of Bloom's Taxonomy; where the scoring and grading procedures are transparent to the student and as objective as possible; where each item can be traced directly back to the standards, student learning objectives, text and source information, and learning experiences.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

11. Performing test analysis involving statistical analysis of students' responses; obtaining item statistics for judging and improving the quality of individual items and for judging and improving the quality of instruction.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

12. Developing student performance tasks to measure what students can do with knowledge; where there is a direct link to traditional tests; which move student learning assessment from "knowing about" to "performing or doing-using knowledge"; where the upper levels of Bloom's Taxonomy or levels of learning are demonstrated.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

13. Designing and developing rubrics for the purpose of scoring (grading) student performances that measure "learning by doing" where students demonstrate what they know by using knowledge to perform a task, etc.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

14. Designing and developing a course where many different teaching models are used throughout the course, e.g. lecture, direct instruction, reciprocal, reciprocal-performance, mastery learning, graphic organizers, concept attainment, conceptualization, inductive thinking, deductive thinking, concept formation, inquiry, training, synectics, psychomotor, metaphorical, non-directive, role play, cooperative/collaborative, etc..

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

15. Designing and developing a course where many different teaching styles are used throughout the semester, e.g. command, practice, self-check, inclusion, guided discovery, convergent discovery, divergent production, learner-designed, learner-initiated, self-teaching styles.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

16. Designing and developing a course that accommodates different learning intelligences and student learning styles. Learning styles as: "characteristic of the cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" or "the way each learner begins to concentrate, process, and retain new and difficult information" or "concrete experience, reflective observation, abstract conceptualization, active experimentation".

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

17. Designing and developing a course where the burden of learning is on the student rather than the professor; where the professor assumes instructional leadership and directs student learning, but is not entirely responsible for "imparting" all the knowledge to be learned "directly"; where students engage actively in their own learning; where lecture is not KING. BE HONEST!

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

18. Designing and developing student learning activities where "cooperative" or "collaborative" learning models are used formally; where "informal", "formal", or "base" structures are used based upon Kagan or Johnson and Johnson strategies throughout the course or for major learning activities.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

19. Designing and developing student learning activities where cooperative learning in small groups provides the opportunity for students to experience accomplishing a goal together; where students would feel that they are gaining self-esteem, respect from others, that they are learning more because they are learning with others, that the experience raised everyone's learning and consequently their grades; where higher level thinking occurs because of students engaging in inquiry together, asking questions of each other; where social skills develop as an outcome; and they increase their capacity to cope with stress or adversity; especially where group learning is designed with performance criteria and where they were trained or educated about group behavior or dynamics.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

20. Designing and developing learning activities where multiple intelligences are required for learning.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

21. Designing and developing problem-based learning where: students are assigned a problem with conditions, constraints, possibilities, that require materials (sometimes), research, collaboration; where students have to take responsibility for their own learning by solving the problem, where the problem crosses the boundaries of disciplines, entwining theory and practice, where there is a focus on the processes of knowledge acquisition, rather than the products of such processes; where the professor is a facilitator rather than instructor, and students will engage in self and peer assessment.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

22. Engaging in the scholarship of teaching, research in the classroom on teaching and student learning using appropriate research design and methodology, analytical or statistical procedures, etc.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

23. Using course evaluation data or information as feedback to determine course changes.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

24. Evaluating the effectiveness of "interventions" or course changes to improve student learning.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

25. Closing the feedback loop and actually making course changes for the purpose of improving student learning.

1	2	3	4
Lack sufficient knowledge, skills, confidence to apply	*Possess some knowledge and skills, but lack sufficient confidence to apply*	*Possess some knowledge and skills; feel somewhat confident to apply*	*Possess high level knowledge and skills; confident to apply*

Faculty Participants

Abul Azad
Brian Coller
Abhijit Gupta
Reinaldo Moraga
Ibrahim Abdel-Motaleb
Regina Rahn
Robert Tatara

I Love Teaching at NIU

NORTHERN ILLINOIS UNIVERSITY

Volume IV-Section D: Presentations

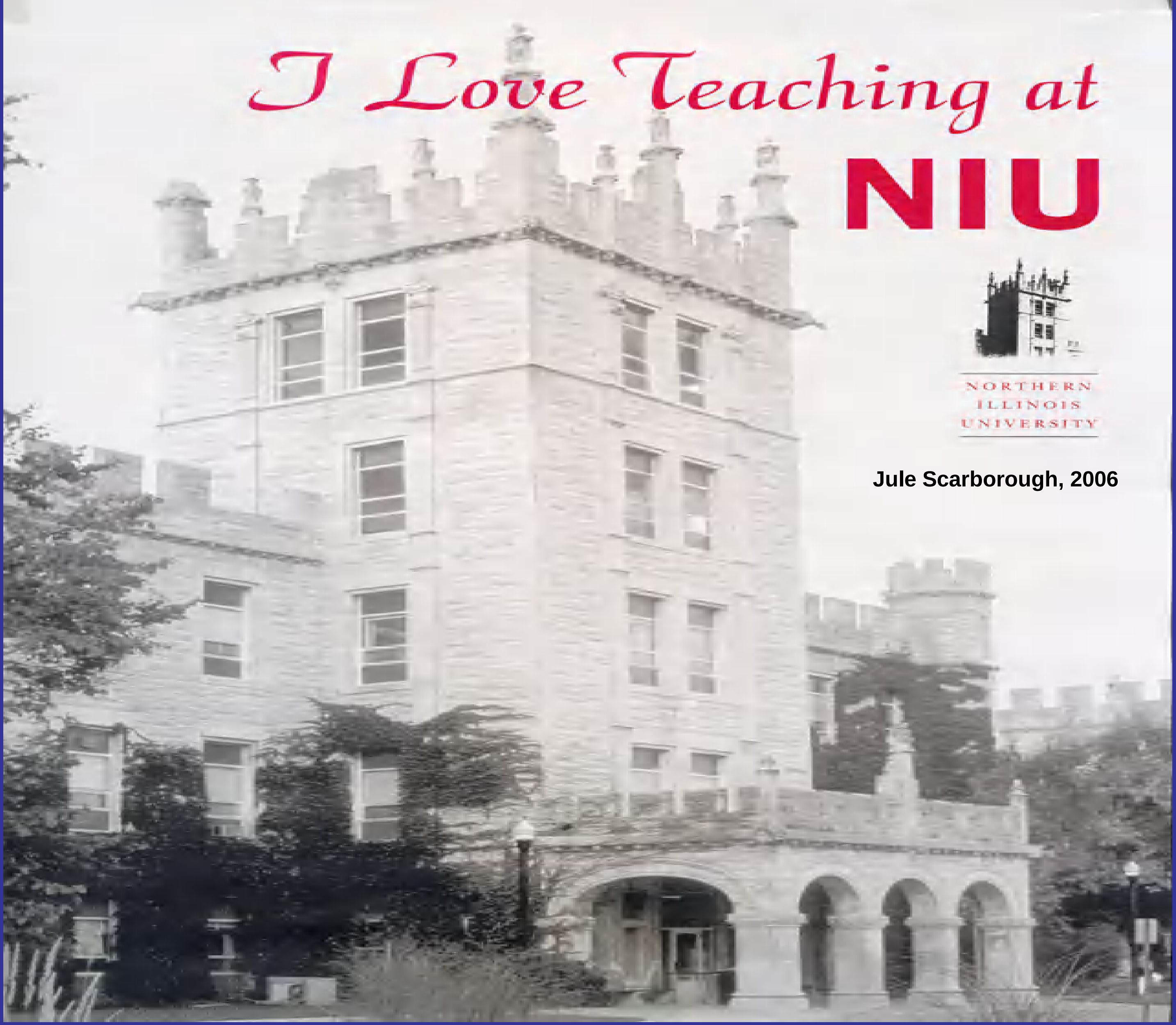
The Scholarship of Teaching
The CEET Initiative on Teaching and Learning

Jule Dee Scarborough, Initiative Director

College of Engineering and Engineering Technology
Promod Vohra, Dean

Program Associate: Jerry Gilmer, Director, NIU Testing Services
Editor: Gail Jacky, Director, NIU Writing Center

October 2005-December 2006



Reflective Practice -The Scholarship of Teaching

(for PowerPoint presentations, contact julescarborough@niu.edu)

Reflective Practice

Preparation for

The Scholarship of Teaching

College of Engineering & Engineering Technology
Initiative on Teaching and Learning
Professional Development Program

Feb. 2 - May 25, 2006

Jule Scarborough, 2006

Metanoia

- Through learning we re-create ourselves.
- Through learning we become able to do something we never were able to do [before].
- Through learning we extend our capacity to create, to be part of the generative* process of life.

(Senge, 1990)

Faculty Learning Communities

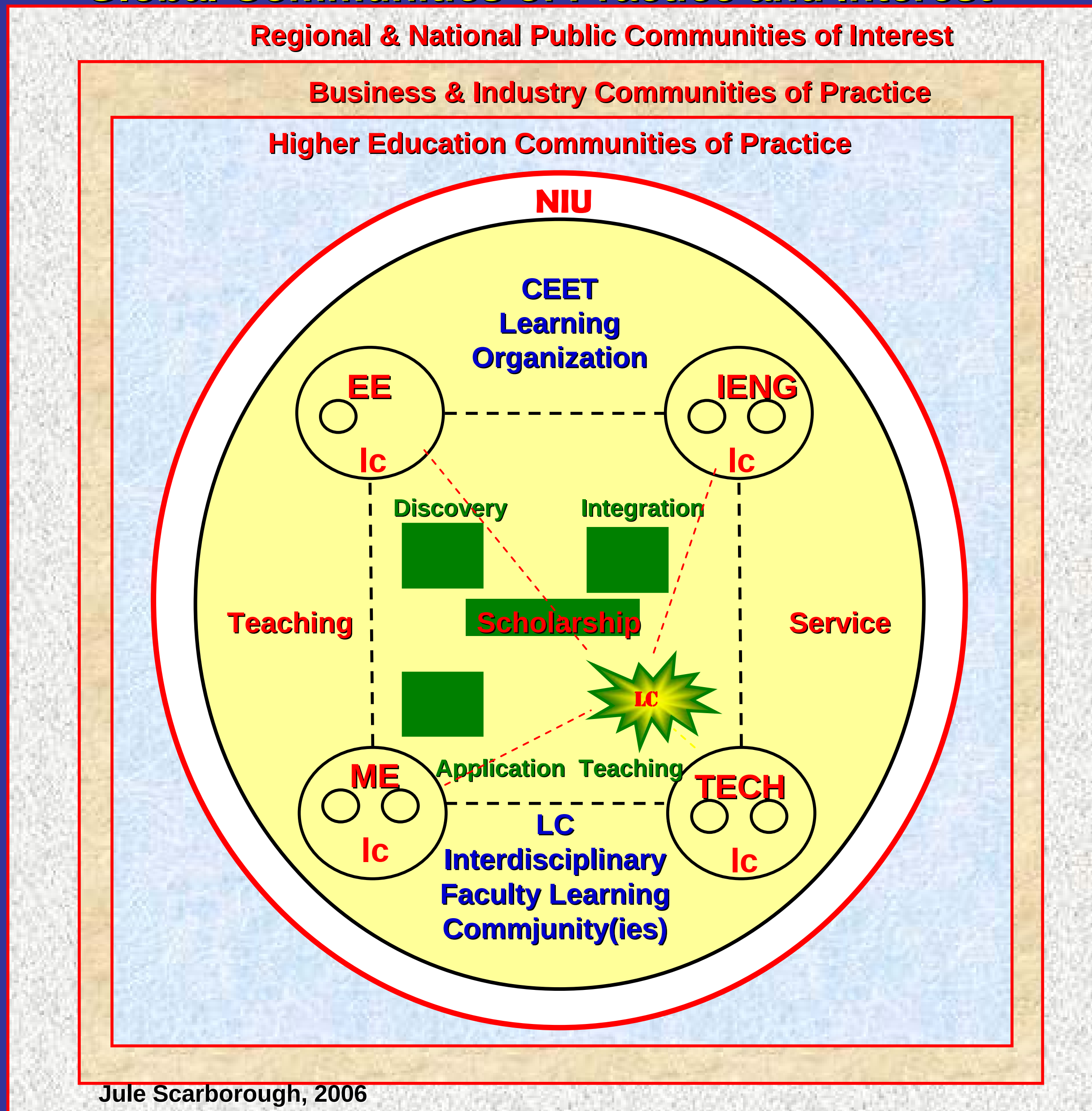
"groups of people gathered together intentionally for the purpose of supporting each other and the process of learning…"

- **Learning Circles**

  "smaller groups of learners within the larger group or community… through professional interaction and [dialog]… where members construct ideas together.. share opinions.. debate issues"

Collay et al. (1998)

Global Communities of Practice and Interest



Jule Scarborough, 2006

Faculty Learning Communities

- a shared goal, problem or project;
- shared resources;
- shared membership and leadership;
- commitment to improvement of professional practice;
- collaborative approaches to groupwork;
- learning and development focused on real work-based issues and practice;
- autonomous community members'
- high levels of dialogue, interaction and collaboration;
- information and knowledge sharing;
- knowledge constructivism;
- knowledge transfer and knowledge exchange;
- use of information and communication technologies. (p.6-7)

Jule Scarborough, 2006

Communities of Practice

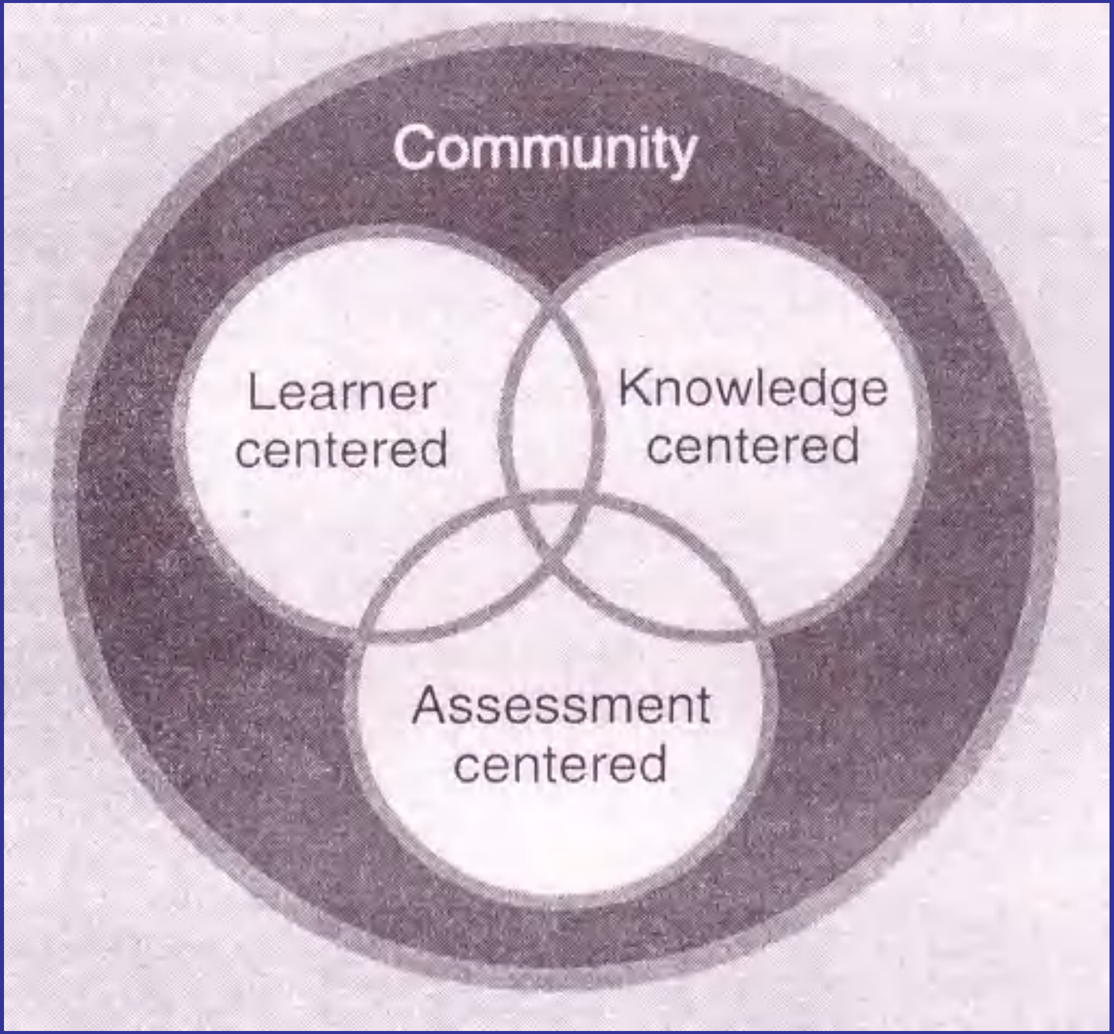
- *"Companies at the forefront of the <u>knowledge</u> economy are succeeding on the basis of **"<u>professional</u>" <u>communities</u> of <u>practice</u>…***

- *Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, who **<u>deepen</u> <u>their</u> <u>knowledge</u> and <u>expertise</u> in this area by interacting on an ongoing basis."***

WE ARE A COMMUNITY OF PRACTICE!

Wenger, McDermott, and Snyder, (2002)

Learning Environments



Bransford et al (1998)

Learning is NOT!

Static

- Listening, memorizing, and then repeating what we recalled
- Where we provide learners with the answers rather then the questions and problems…

Learning IS!

Dynamic

★ Society, the real world, requires learners to actively plan, observe, test, and reflect, rather than be passive….

★ Active, inquiry-based, learning puts the burden of learning on the learner to explore the unknown

Thomas et al, (2005)

Learning **IS NOT** synonymous with "taking in information"

*Generative Learning

"learning that enhances our capacity to create"

Jule Scarborough, 2006

Transformative Learning

Grants **power** to the **learner**…

– to **relate** to the subject matter

– to build upon existing knowledge

– to construct new knowledge, and…

– **Empowers** one to **create** their desired **future**

(Senge, 2000)

Learning = Shift of Mind= Metanoia

- From seeing ourselves …
- as Separate from the world
- to…Connected to the world
- to…Transforming the world
- to…Creating the world

Jule Scarborough, 2006

(Senge, 1990, 2000)

Pedagogy

– **<u>Transmission</u> <u>Pedagogy</u>**– **takes power away** from the learner and the teacher

– **<u>Generative</u> <u>Pedagogy</u>** – grants the power to **relate** to the subject matter and **build** on existing knowledge for both the teacher and the learner

– **<u>Transformative</u> <u>Pedagogy</u>** – grants the **power** to **create** one's desired future for both teachers and learners

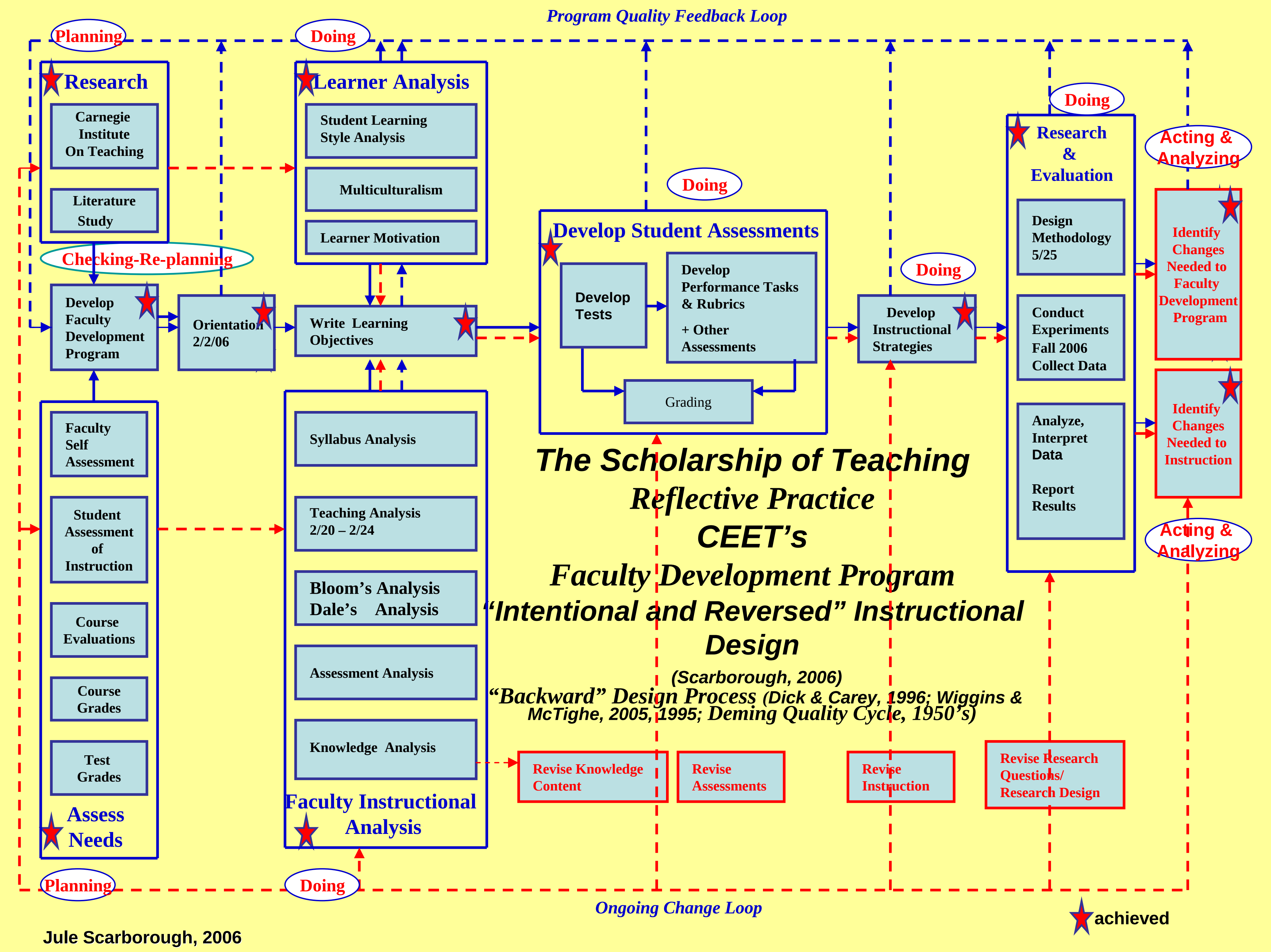
(Senge, 2000)

Self-assessment

Does our teaching have purpose, meaning, focus?

- **Critical Questions:**
  - Do our courses have integrity?
  - Do our assessment strategies/procedures have integrity?
  - Do our teaching processes have integrity?
  - Do our educational products have integrity?
  - Do we as professors have integrity?
  - Do our syllabi have integrity?
  - Are we creating a learning communities of students where they can “make meaning” of new knowledge?
  - Do we deliver on “promises” to students?
  - Are we “transforming leaders” ?(Burns, 1978)

Jule Scarborough, 2006


Program Quality Feedback Loop
Planning
Research
Carnegie Institute On Teaching
Literature Study
Checking-Re-planning
Develop Faculty Development Program
Orientation 2/2/06
Faculty Self Assessment
Student Assessment of Instruction
Course Evaluations
Course Grades
Test Grades
Assess Needs
Planning
Doing
Learner Analysis
Student Learning Style Analysis
Multiculturalism
Learner Motivation
Write Learning Objectives
Syllabus Analysis
Teaching Analysis 2/20 – 2/24
Bloom's Analysis
Dale's Analysis
Assessment Analysis
Knowledge Analysis
Faculty Instructional Analysis
Doing
Doing
Develop Student Assessments
Develop Tests
Develop Performance Tasks & Rubrics
+ Other Assessments
Grading
Doing
Develop Instructional Strategies
Doing
Research & Evaluation
Design Methodology 5/25
Conduct Experiments Fall 2006 Collect Data
Analyze, Interpret Data
Report Results
Acting & Analyzing
Identify Changes Needed to Faculty Development Program
Identify Changes Needed to Instruction
Acting & Analyzing
The Scholarship of Teaching
Reflective Practice
CEET's
Faculty Development Program
"Intentional and Reversed" Instructional Design
(Scarborough, 2006)
"Backward" Design Process (Dick & Carey, 1996; Wiggins & McTighe, 2005, 1995; Deming Quality Cycle, 1950's)
Revise Knowledge Content
Revise Assessments
Revise Instruction
Revise Research Questions/ Research Design
Ongoing Change Loop
achieved
Jule Scarborough, 2006

Professional Development Program
Reflective Practice

- Learning Communities
- Scholarship of Teaching

- Course Analysis

- Student Learning Outcomes -→ ABET/TAC/NAIT Outcomes --→ Test Items Analyzed by Dale and Bloom

- Traditional Test Analysis and Development
- Performance Assessment and Rubric Development
- Other Assessments
- Map of Assessments

- Teaching Models (20 Joyce, Weil, and Calhoun)
- Cooperative Learning (Johnson, Johnson, and Smith)
- Concept Mapping as a model or assessment process (multiple sources, styles, etc.)

- Multiculturalism in Courses
- Grading - What do they mean and how should it be done with integrity
- Experimental Research on Teaching and Learning

CEET Initiative on Teaching & Learning

- The CEET Scholarship of Teaching Initiative (CITI) is based upon the following:
- CEET Vision: To build a regional and national reputation for the scholarship of teaching.
- CEET Mission: To build an interdisciplinary team of faculty who understand the four types of scholarship as defined by Boyer (1990), have the capability of engaging in either or several of the types of scholarship, are who are stimulated to engage in scholarship activities, research on teaching and student learning in their disciplinary classrooms.
- CEET Promotion and Tenure Objective: To redefine scholarship across its department and make acceptable for promotion and tenure purposes, either or a mix of productivity across the types of scholarship as defined by Boyer (1990).
- CEET Goal for Faculty: To engage in scholarship of teaching, either as, or alongside their other scholarship interest(s).
- CEET Scholarship Goal: To adopt standards for quality performance in scholarship. (Glassick et al, 1997).
- CEET Goal: To institutionalize and sustain a program of faculty development on teaching, student learning, and educational research to prepare faculty to engage in scholarship of teaching through action research in the classrooms.
- CEET Goal for Students: To develop student learning communities where learners in the truest sense to: engage actively in constructing broader knowledge frameworks, make deeper meanings, increase transfer across contexts and that these students leave us with such excitement about what they have learned that they continue to seek to learn, extending what they learned with us into new meanings through their new experiences and opportunities throughout their career.

Faculty Learning Community

- "transformative" learning communities are those which enable:

  "like-minded people, colleagues, or professionals with a common or multi-professional interest to <u>work</u> <u>together</u> and to <u>achieve</u> a particular aim or organizational objective."

Expected Outcomes:

1. **Research action and results to base further research upon**
2. **Faculty enabled to engage in the scholarship of teaching**
3. **The redefinition of the relationship of teaching to research with the adoption of modified bylaws that will reflect the four areas of scholarship as those proposed by Boyer (1990): discovery, integration, application, and teaching.**

Products:

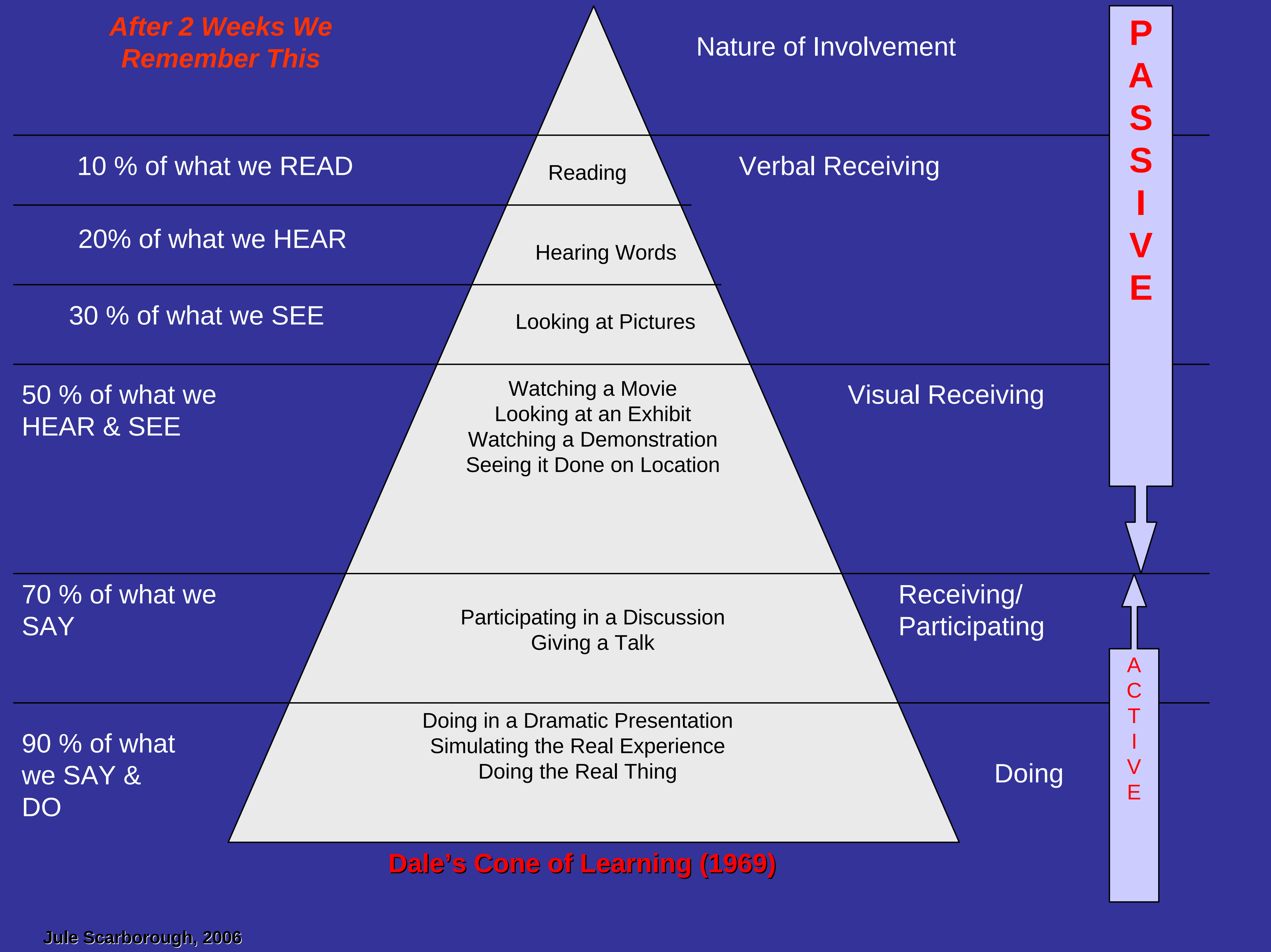
1. **CEET faculty professional development model and program**
2. **Faculty leadership team**
3. **Classroom, or student learning, pilot research results**
4. **New or revised T/L educational products, e.g. student assessments, syllabi, models and processes, feedback instruments, others TBD.**
5. **National publications and presentations (to be submitted with intent of acceptance)**
6. **Proposals for on-going research (to be submitted with intent of acceptance)**
7. **Faculty leadership team**
8. **Proposals to modify faculty evaluation procedures to include scholarship of teaching as an acceptable form of research towards promotion and tenure**

Teaching Professionals

1. emphasize <u>learning</u> rather than teaching.
2. emphasize <u>active</u> student engagement with <u>significant</u> content.
3. focus on student <u>performance</u> and <u>production</u>.
4. routinely <u>collaborate</u> with their colleagues.
5. are <u>students</u> (themselves) of teaching and <u>consumers</u> of research.
6. function as leaders for …

"every great leader is clearly teaching and every great teacher is leading"
(Gardner, 1986, p. 19)

(Schlechty, 1997)


After 2 Weeks We Remember This
Nature of Involvement
10 % of what we READ
Reading
Verbal Receiving
20% of what we HEAR
Hearing Words
30 % of what we SEE
Looking at Pictures
50 % of what we HEAR & SEE
Watching a Movie
Looking at an Exhibit
Watching a Demonstration
Seeing it Done on Location
Visual Receiving
70 % of what we SAY
Participating in a Discussion
Giving a Talk
Receiving/ Participating
90 % of what we SAY & DO
Doing in a Dramatic Presentation
Simulating the Real Experience
Doing the Real Thing
Doing
PASSIVE
ACTIVE
Dale's Cone of Learning (1969)
Jule Scarborough, 2006

Bloom's Taxonomy of Learning

"Levels"

Bloom, (1956)

Evaluation
-students make critical judgments about relative worth of ideas, products & positions as they take positions & justify

Synthesis
-students exploit their mastery of concepts to create new and original products, ideas and/or solutions

Analysis
-students take apart concepts, ideas and/or products in order to identify patterns & relationships

Application
-students are able to exploit their understanding of factual material to solve problems and design and make products

Comprehension
-students make sense of factual material and are able to employ this understanding to represent the information in a variety of media and or genres

Knowledge
-students engage factual material and able to recall and describe facts

Bloom's Revised Taxonomy of Learning

Anderson & Krathwohl, (2001)

The Knowledge Dimension	The Cognitive Process Dimension					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Meta-Cognitive Knowledge						

Scholarship

Scholarship of discovery

Knowledge for knowledge sake - the creation of a bank of knowledge or information, ready to draw upon when the time for intelligence use arrives.

Scholarship of Integration

Authenticating knowledge through analysis and interpretation, establishing meaning or original research through interdisciplinary consideration and synthesis.

Scholarship

Scholarship of Application

Where scholarship connects theory and practice and proves its worth to the nation and world.

Scholarship of Teaching …

Where scholarship connects or develops theory and practices on teaching and learning for the increase of student learning and the improvement of teaching

"Teaching is the Highest Form of Understanding."

Good teaching means that faculty, as scholars, are also learners … researchers about learning

transforming and *extending knowledge through scholarship*

Without the teaching function, the continuity of knowledge will be broken and the store of human knowledge dangerously diminished.

Boyer (1990)

The Scholarship of Teaching and Learning in Engineering and Technology

- <u>Scholarship</u> <u>of Discovery</u> - historically primary

"A scientist discovers that which never was…"

An engineer creates that which never was…."

Historically, design was a <u>linear</u>, morphological process…formal process

Recently, design is less formal…designs are generated through a more <u>social</u> process

Principles to Improve Undergraduate Education

Good Practice:

- Principle 1: encourages student-faculty contact
- Principle 2: encourages cooperation among students – Cooperative Learning Communities
- Principle 3: encourages Active Learning
- Principle 4: gives students prompt feedback
- Principle 5: emphasizes time on task
- Principle 6: communicates high expectations
- Principle 7: respects diverse talents and ways of learning

Changing Contexts

- **NSF began to shift funding <u>away</u> from single-investigator research to multidisciplinary centers —**

  resulting in legitimizing <u>scholarships</u> of <u>integration</u> and <u>application</u> to address important national problems, e.g.
  energy production, environmental science, technoloy, biotechnology…

- **Students are more diverse**

- **The Journal of Engineering Education has become the primary source on engineering education in the world…**

- **It focuses on educational principles as well as educational classroom experiments (1991)**

Research-Teaching and Learning

- **Advanced because of NSF programs**
- **New Engineering Criteria 2000**

(emphasize standards and assessment of learning outcomes)

- **Led to substantial <u>increase</u> in <u>scholarship</u> of <u>teaching</u> and <u>learning</u> with ultimate goal of <u>improving</u> teaching and learning…**
- **Engineering schools are beginning to focus on <u>how to prepare faculty</u> to implement new teaching and assessment methods**
- **Faculty development <u>programs</u> critical to the development of faculty and grad learning communities focused on STL**
- **NSF program Engineering Education Scholars, etc.**

The Scholarship of Teaching and Learning in Engineering and Technology

Most data from Engineering Scholarship of teaching and learning is <u>qualitative</u>

Need more experimental/control studies

Will improve research credibility

NSF wants experimental research

Social science research is “messy” – quite different from typical engineering research

Requires engineering adjustment……

Assessing Educational Scholarship

Felder (2000) suggests that faculty reviews for promotion should ask:

1. To what extent does the instructor's teaching qualify as a scholarly activity?

2. How effective is the instructor's teaching?

3. How numerous and effective are the instructors educational research and development efforts?

Piaget

The principal goal of education is to:

"create people who are capable of doing new things, <u>not</u> simply repeating what other generations have done…

People who are creators, inventors, discoverers.

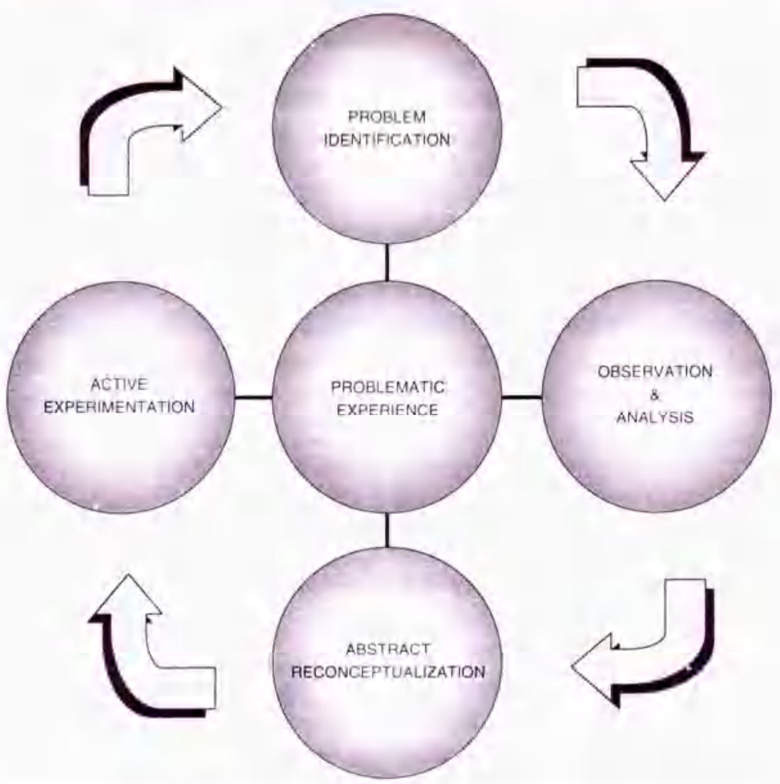
The second goal of education is to:

"form minds that are critical, can verify, and do not accept everything they are offered"

Jule Scarborough, 2006

Reflective Practice

Figure 1.1 Reflective Practice: An Experiential Learning Cycle



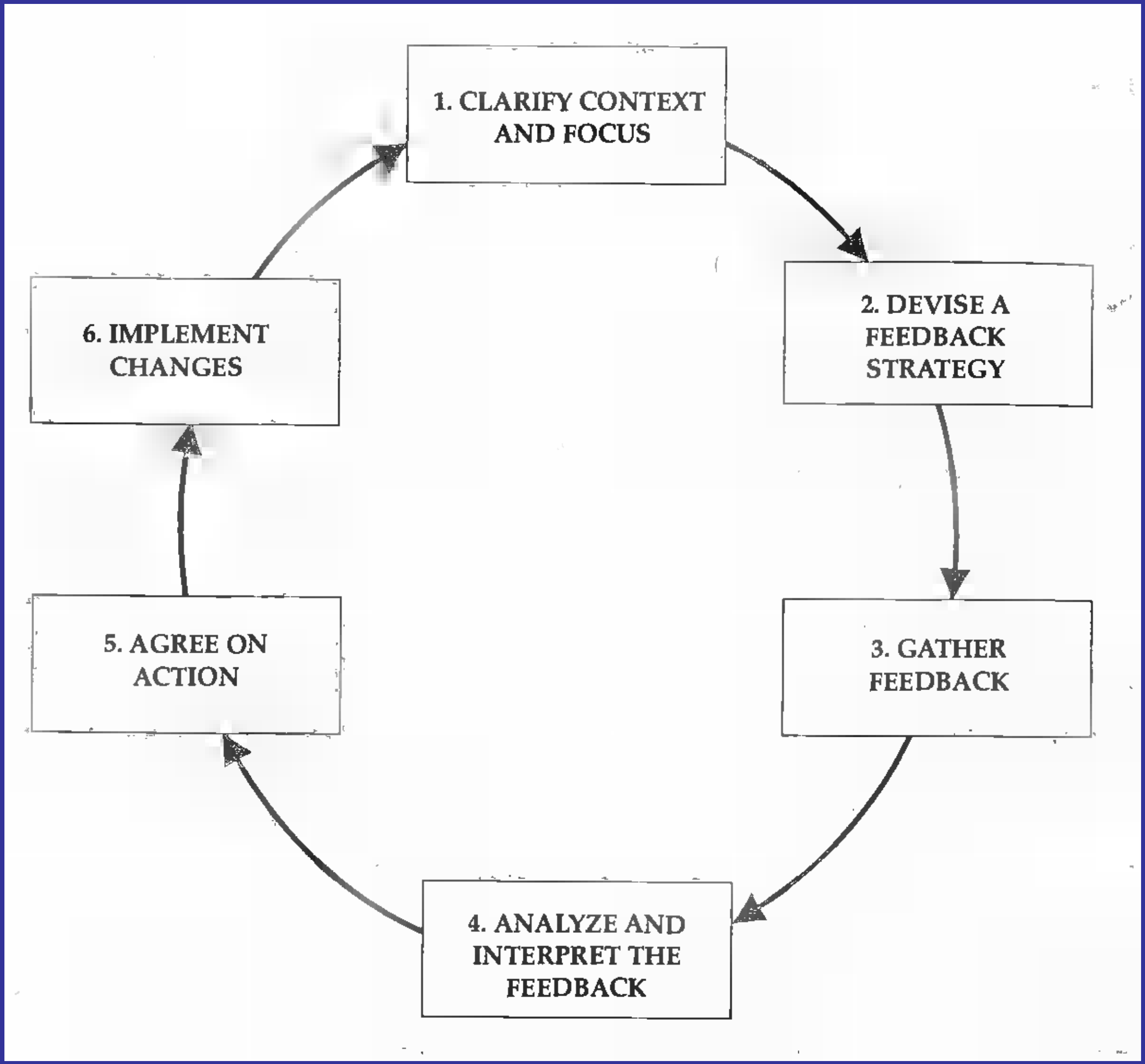
SOURCE: Osterman and Kottkamp, *Reflective Practice for Educators, Second Edition*. Copyright © 2004 by Corwin Press. Reprinted with permission.

Sullivan & Glanz, 2006

Figure 6.1. Amount of Time Spent Preparing Relative to Teaching Quality

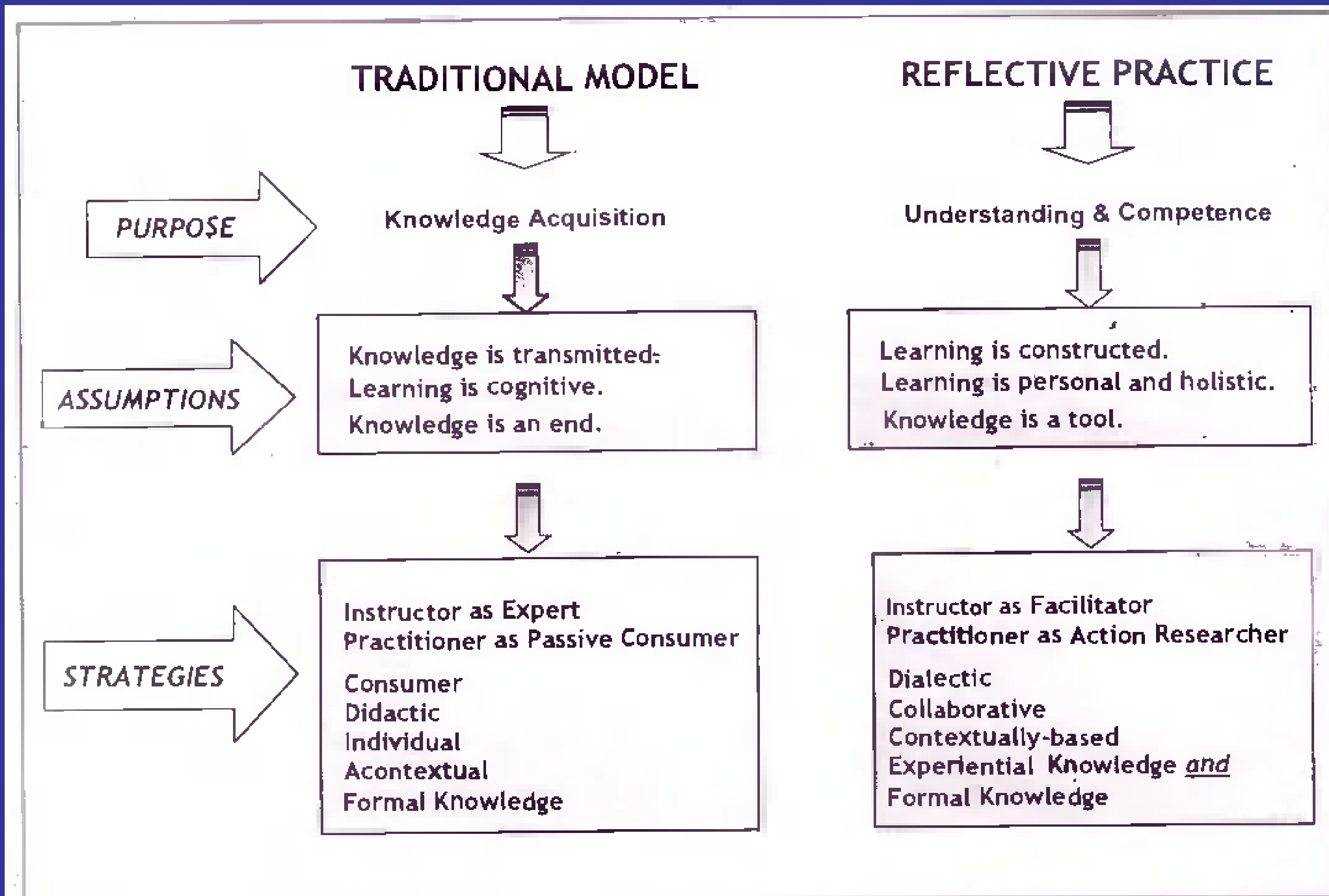
Shally in Frost & Taylor (1996) p. 69

Fig. 14.2 The Evaluation Cycle



Hounsell in Fry et al (2003) p. 210

Fig. 1.2 Contrasting Approaches to Professional Development



Osterman & Kottkamp (2005) p. 16

Fig. 2.3 Finding Discrepancies: Developing a Critical Perspective on Practice

Describe Espousals

Espoused Theory
What are my explicit beliefs?

Intended Action
How did I intend to act?

Goals
What do I hope to accomplish?

Examine Practice

Action
What did I do?

Outcomes
What occurred as a result of my actions?

Contrast Espousals with Practice

Theory-in-Use
What ideas shape my actions?

Action
Did I act as I intended?

Outcomes
Were my actions effective?

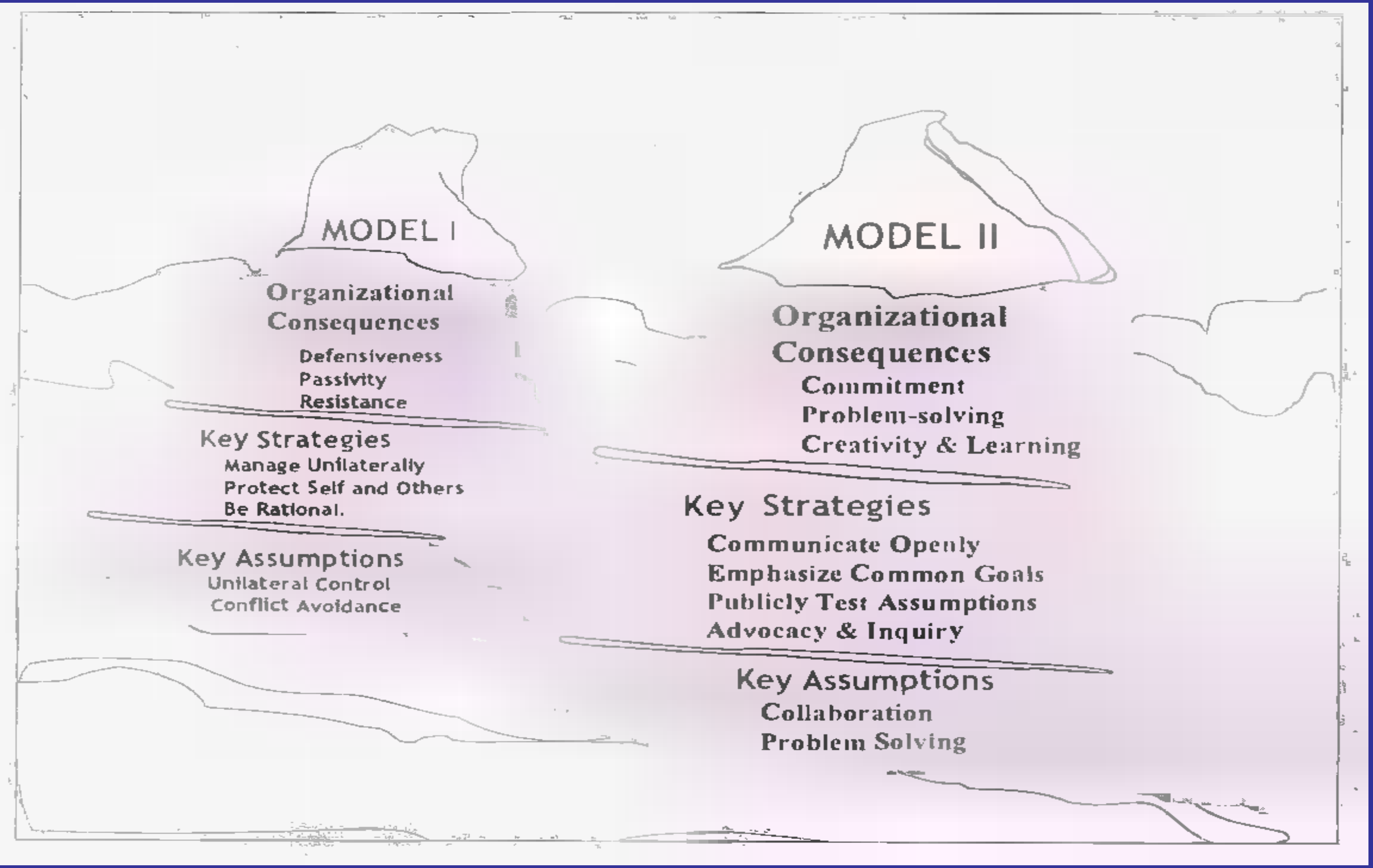
Examine Personal Practice in Context of Theory and Research

Theory | *Action* | *Predicted Outcomes*

What strategies predictably lead to desired outcomes?
What does research tell us about good practice?
Is my practice "best practice"?

Osterman & Kottkamp (2005) p. 36

Fig. 4.1 Contrasting Model I and Model II



Osterman & Kottkamp (2005) p. 70

Scholarship of Teaching

- Learning Community –
- Professional Development Program
- Execute Program
- Collect data on learning:
  - Student assessment
  - Self assessment
  - Competency assessment
  - Program content assessments
  - Teaching Portfolios – exhibits of change & growth

Scholarship of Teaching

- Where are We?

- Questions about Experimental Research!!!

  (with control groups in intact classes)

  – Design
  – Methodology
  – Student Fairness
  – Process
  – Results -- what if we don't show significant scores?

Scholarship of Teaching

Pilot or Research?

Tool Box on Teaching & Learning

- **Includes:**

8 Field Prioritized Books

100+ Articles – what we couldn’t buy with Dean Vohra’s budget, we copied! We quit counting!

Assessment Tools

Program Materials

Teaching Portfolio

- **Self Assessment Baseline:**
- _____Student Questionnaire
- _____Professor completion of Student
- Questionnaire
- _____Professor Self Competency
- Questionnaire

- **Course Analysis:**
- _____GAPS Analysis on- TM, TS, LS, B, D
- _____ABET/TAC/NAIT SLO by Bloom's
- Analysis
- _____Course Calendar by TM, TS, LS, B, D
- _____Teaching Models+Cooperative
- Learning+Mapping Study Chart

- **Student Centered Course Syllabus:**
- _____All new components and check off list

- **Multifaceted Assessment System:**
- _____Chart
- _____Assessment Analysis by Bloom
- (Chart)

- **Traditional Objective Tests:**
- _____Test Analysis
- _____Table of Specifications
- _____Test Item Bank
- _____New Midterm Exam
- _____New Final Exam
- _____Test Items by SLO chart

- **Performance Assessment & Rubrics:**
- _____3 Complex Performance
- Assessments
- with multiple tasks embedded
- _____3 Rubrics, one to score each
- Performance
- Assessment and to be used with
- students to establish standards
- up front
- **Other Assessments of Individual Choice:**

Final Teaching Portfolio Report

Teaching Portfolio as Assessment

- Reflection and Response to Cues
- ShowCase & Growth

Scholarship of Teaching

Classroom Research

Tentative Research Designs

Study 1

Traditional Assessment With Performance Assessment

1. Does a performance test administered in conjunction with a traditional cognitive test result in **increased learning** beyond the traditional test alone as indicated by the traditional cognitive test?

2. Does a performance test administered in conjunction with a traditional cognitive test result in **increased** knowledge **retention** beyond the traditional test alone as indicated by a final exam?

Tentative Research Designs

<u>Study 1</u>:

Traditional Assessment With Performance Assessment

Study 1: Traditional Assessment With Performance Assessment

		Treatment	Posttest 1		Posttest 2
Experimental Group	Instruction	Performance Test Related to Traditional Test	Traditional Test	----------→	Traditional Final
Control Group	Instruction	Performance Test <u>Not</u> Related to Traditional Test (Placebo)	Traditional Test	----------→	Traditional Final

Jule Scarborough, 2006

Tentative Research Designs

Study 2

Performance Assessment and Traditional Assessment Administered in Different Order

1. Does a performance test administered in conjunction with a traditional cognitive test result in **increased learning** beyond the traditional test alone as indicated by the traditional cognitive test?

2. Does the order of administration of a performance test **and** a traditional test affect **knowledge retention** as indicated by a final exam?

Tentative Research Designs

Study 2:

Performance Assessment and Traditional Assessment Administered in Different Order

Group 1	Instruction	Performance Test	Traditional Test	-----------→	Final Exam
Group 2	Instruction	Traditional Test	Performance Test	----------→	Final Exam

Jule Scarborough, 2006

Tentative Research Designs

Study 3
Passive Learning vs. Active Learning

- 1. Does <u>passive</u> learning vs. <u>active</u> learning result in **differential knowledge gains** as indicated by a traditional cognitive test?

- 2. Does <u>passive</u> learning vs. <u>active</u> learning result in **differential knowledge retention** as indicated by a final exam?

Tentative Research Designs

Study 3:

Passive Learning vs. Active Learning

Study 3: Passive Learning vs. Active Learning				
	Treatment	Posttest 1		Posttest 2
Passive Learning Group	Passive Learning	Traditional Test	----------→	Final
Active Learning Group	Active Learning	Traditional Test	----------→	Final

Treatment				
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Passive	Active	Passive	Active
2	Active	Passive	Active	Passive

Jule Scarborough, 2006

Tentative Research Designs

Study 4

Individual Learning vs. Cooperative Learning

1. Does individual learning vs. cooperative learning result in **differential knowledge gains** as indicated by a traditional cognitive test?

2. Does individual learning vs. cooperative learning result in **differential knowledge retention** as indicated by a final exam?

Tentative Research Designs

Study 4

Individual Learning vs. Cooperative Learning

	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Traditional Test	----------→	Final
Cooperative Learning Group	Cooperative Learning	Traditional Test	----------→	Final

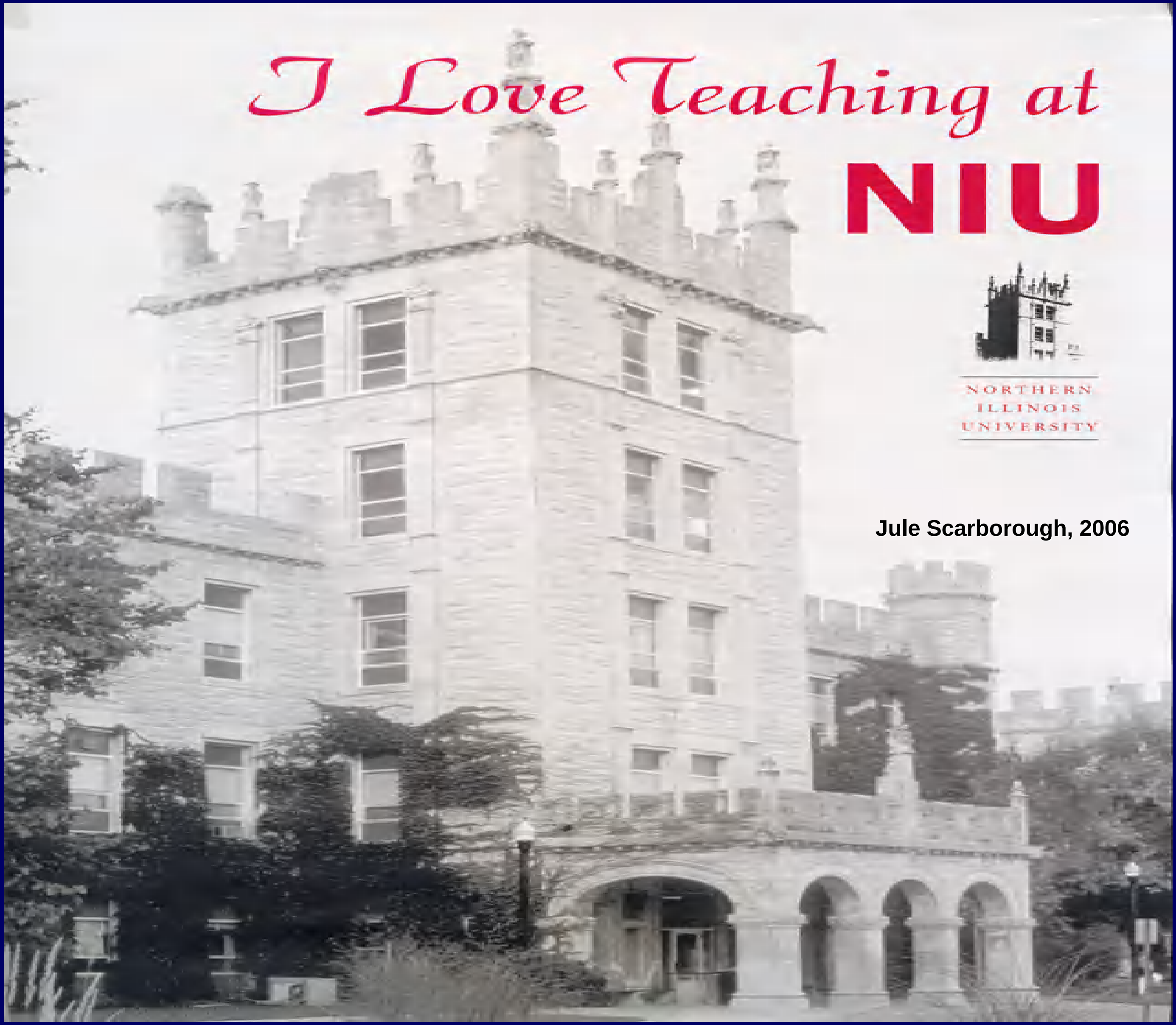
Treatment				
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Individual	Cooperative	Individual	Cooperative
2	Cooperative	Individual	Cooperative	Individual

Jule Scarborough, 2006

Next Steps for Learning Community for Scholarship of Teaching to Begin Formally

- Consider “pilots” vs. “research”
- Determine FUTURE of Formal Learning Community – Formalize operations
- Read and discuss research thoroughly – engage
- Study “TOOLBOX” Contents!!
- Consider support needs
- Begin to write articles based upon learning so far
- Begin to “consider” proposals
- If Research:

“Tweak” courses for experiments – formalize treatments



Learning – What Does It Mean?

(for PowerPoint presentations, contact julescarborough@niu.edu)

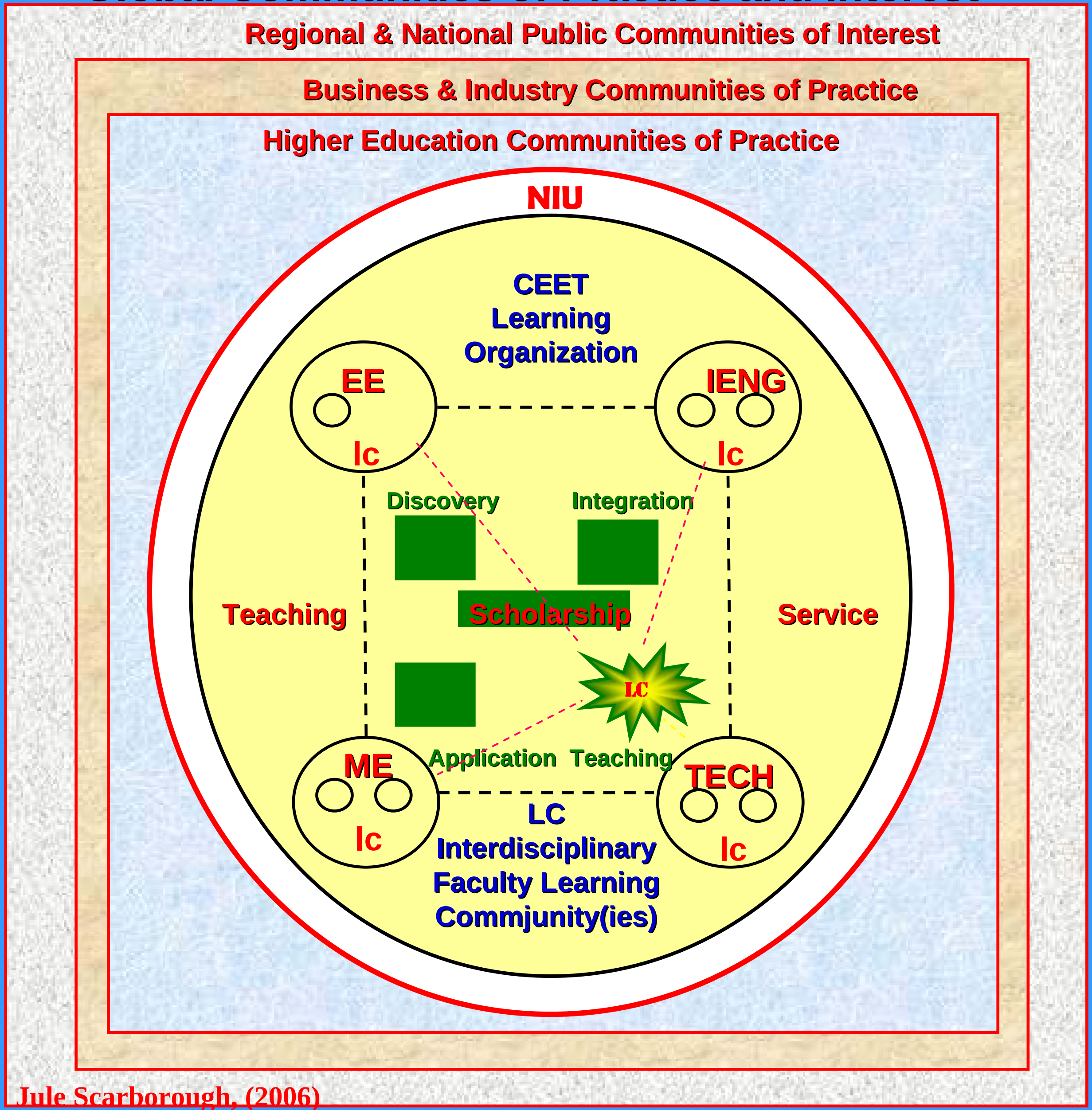
Universities

Teaching vs. Research

The Dilemma

Jule Scarborough, 2006

Global Communities of Practice and Interest



Jule Scarborough, 2006

- Professors’ Professional Responsibility & Duty
  - Teaching “Duty” = “core of universities mission & the faculty’s academic duty
  - Scholarship “Discovery”, “Integration”, “Application”, “Teaching”
  - Service
- As teaching professors, it is our job to:
  - remove barriers to learning
  - create learning environments where students can succeed
  - create new avenues/paths for learning
  - be professional
    - use best practices list
    - base teaching on research
    - engage in “The Scholarship of Teaching”
    - engage in “action” research
    - others

Kennedy, (1997)

As professors…

- What is our product?
- Who is our customer?

Public Demands !

- National
- Illinois Citizens Agenda- Goal 2
  - *"Higher education will join elementary and secondary education to improve teaching and learning at all levels"*

An Illinois Directive!

- Improved Teaching and Student Learning K- University

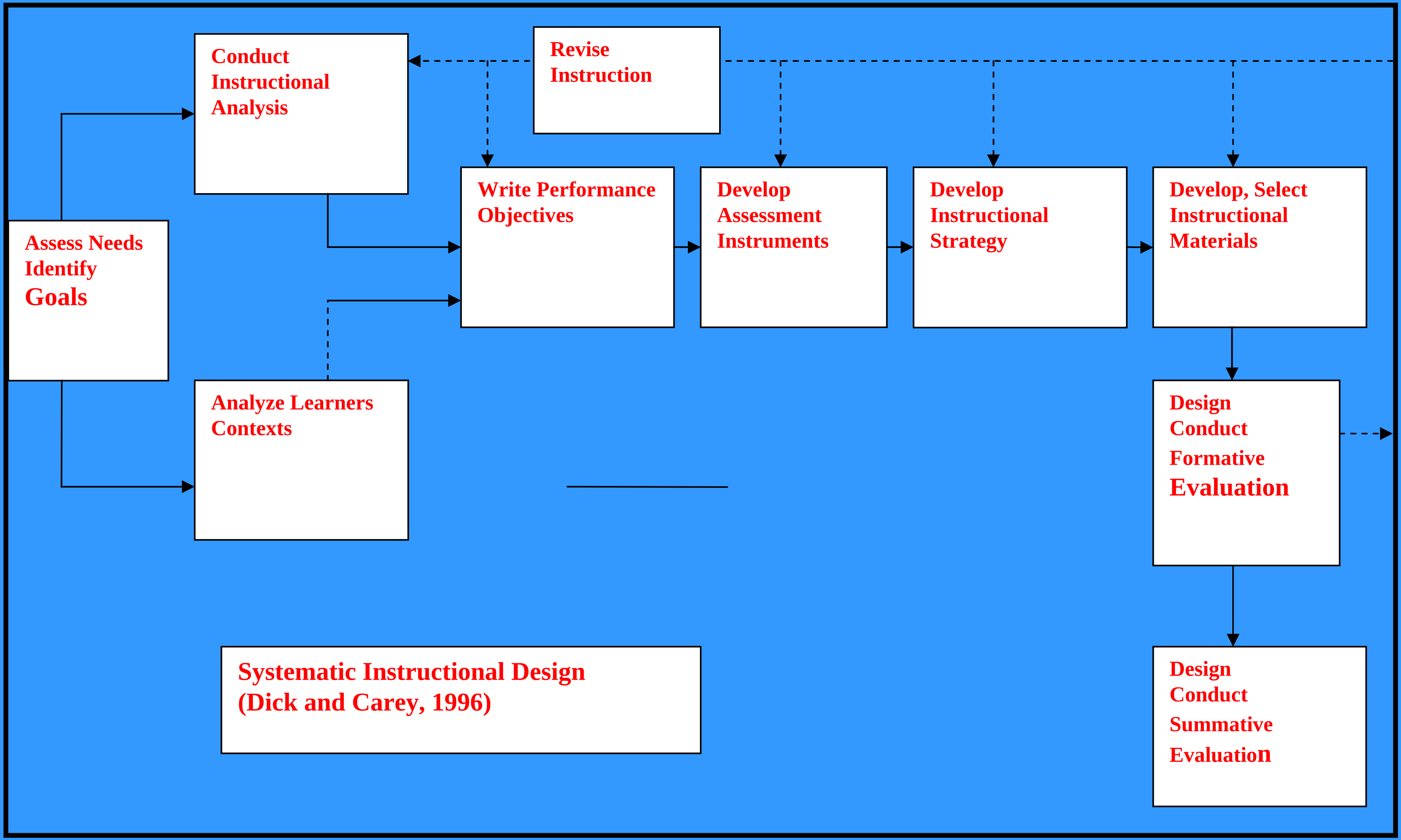
Illinois Citizens Agenda (1999)

Research on Teaching & Learning

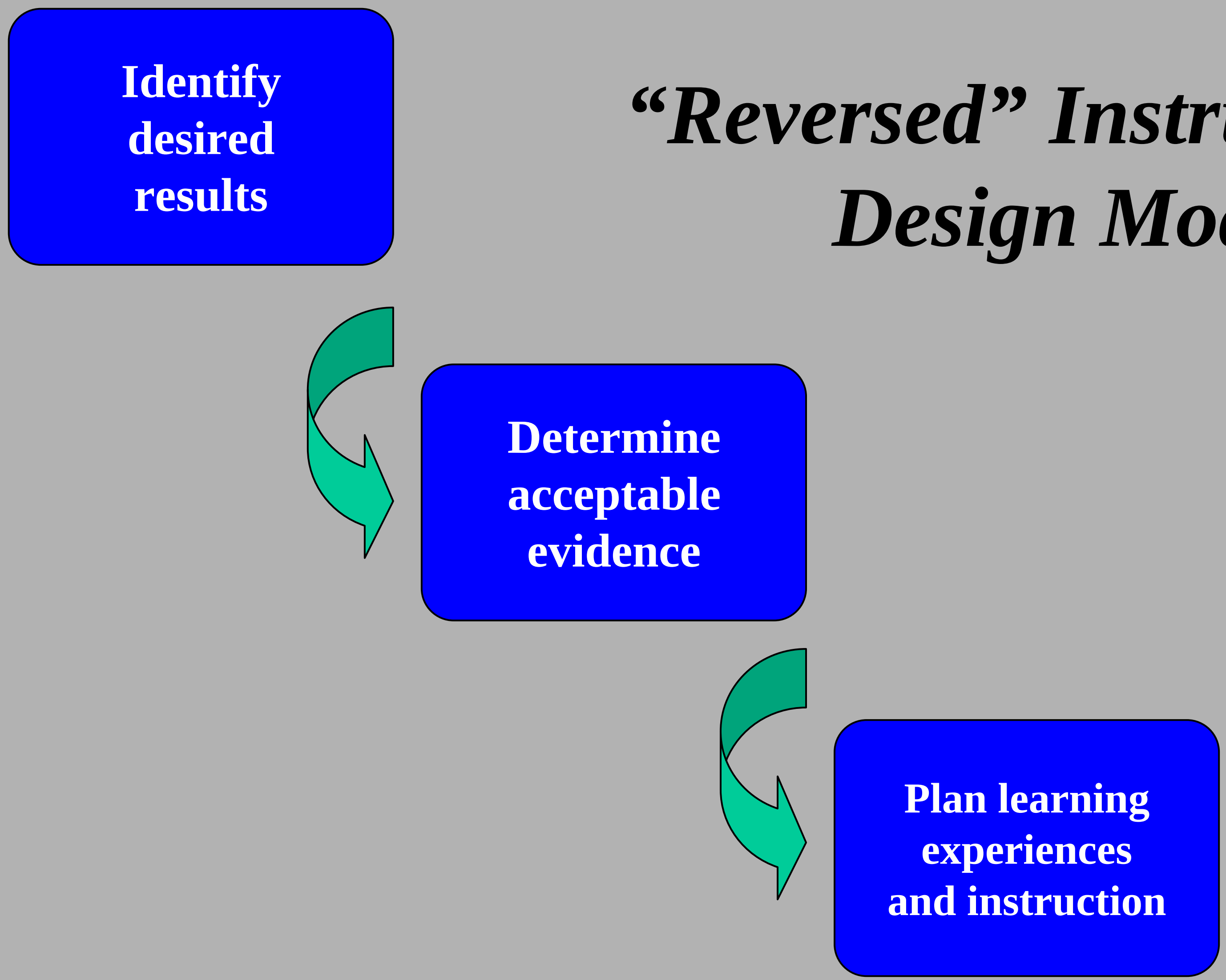
- Scholarship of Teaching
  - Formal research

- Action Research
  - Informal and evaluative inquiry

Systematic Instructional Design

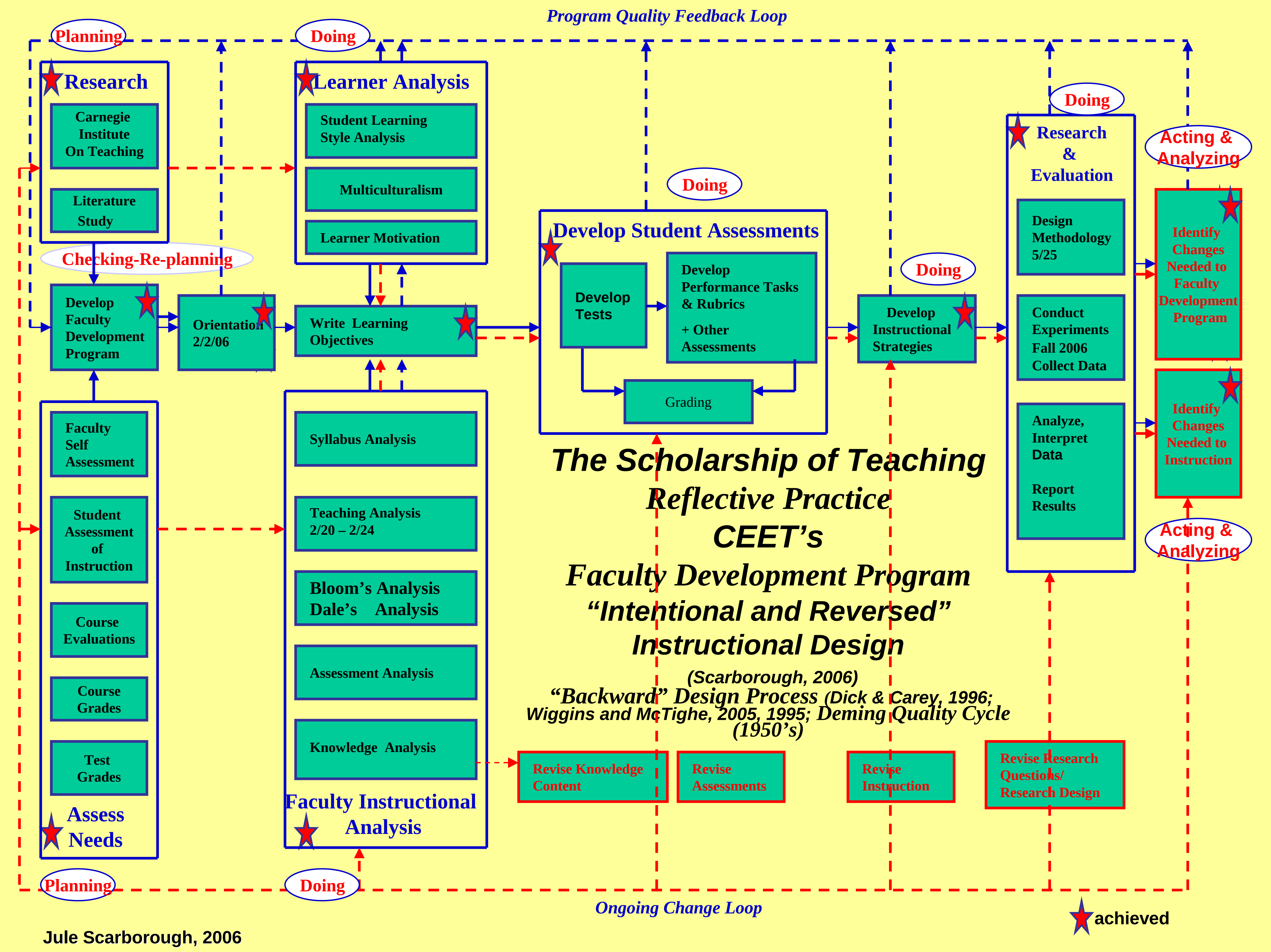


"Reversed" Instructional Design Model



Jule Scarborough, 2006

Wiggins & McTighe (1995)



Program Quality Feedback Loop
Planning
Doing
Research
Carnegie Institute On Teaching
Literature Study
Checking-Re-planning
Develop Faculty Development Program
Orientation 2/2/06
Learner Analysis
Student Learning Style Analysis
Multiculturalism
Learner Motivation
Write Learning Objectives
Doing
Develop Student Assessments
Develop Tests
Develop Performance Tasks & Rubrics
+ Other Assessments
Grading
Doing
Develop Instructional Strategies
Doing
Research & Evaluation
Design Methodology 5/25
Conduct Experiments Fall 2006 Collect Data
Analyze, Interpret Data
Report Results
Acting & Analyzing
Identify Changes Needed to Faculty Development Program
Identify Changes Needed to Instruction
Acting & Analyzing
Faculty Self Assessment
Student Assessment of Instruction
Course Evaluations
Course Grades
Test Grades
Assess Needs
Syllabus Analysis
Teaching Analysis 2/20 – 2/24
Bloom's Analysis
Dale's Analysis
Assessment Analysis
Knowledge Analysis
Faculty Instructional Analysis
The Scholarship of Teaching
Reflective Practice
CEET's
Faculty Development Program
"Intentional and Reversed"
Instructional Design
(Scarborough, 2006)
"Backward" Design Process (Dick & Carey, 1996; Wiggins and McTighe, 2005, 1995; Deming Quality Cycle (1950's)
Revise Knowledge Content
Revise Assessments
Revise Instruction
Revise Research Questions/ Research Design
Planning
Doing
Ongoing Change Loop
achieved
Jule Scarborough, 2006

Learning Organization- CEET

- Faculty Learning Community

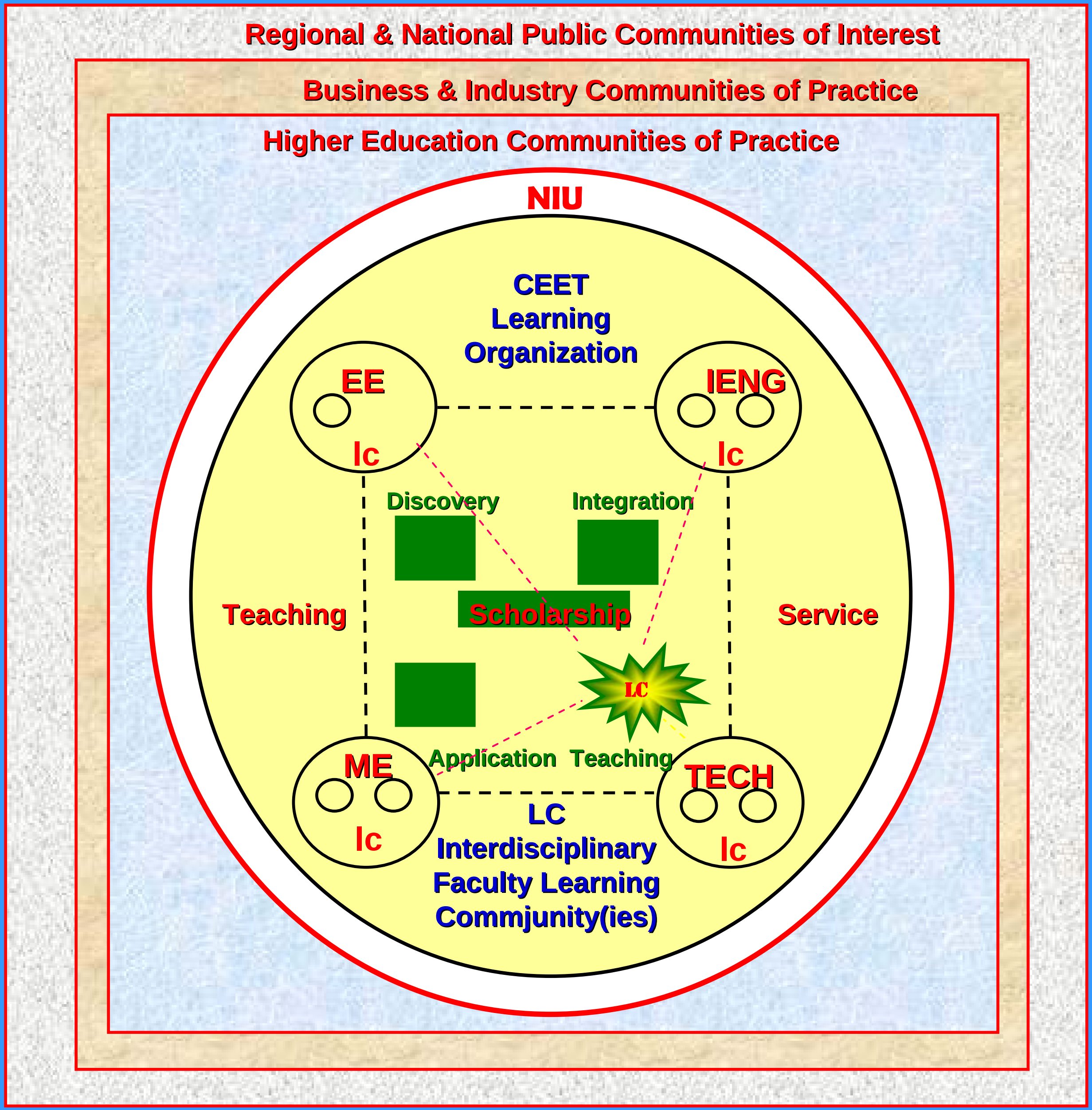
  Faculty Learning Circles/Teams

- Faculty & Student Learning Communities

  Student Learning Communities

  Student Learning Circles/ Teams

Global Communities of Practice and Interest



Jule Scarborough, 2006

Learning Organizations

- Universities…

  "consciously structured to promote their own learning and that of their students and faculty members…" rather than

" individual, isolated, passive learning"

Tinto (1997) in Lenning and Ebbers, (1999).

Learning Community

- *“ An intentional means to a particular end, which is to maximize learning of groups and individuals”*

Lenning and Ebbers, (1999).

-Faculty Learning Communities

-Student Learning Communities

-Faculty & Student Learning Communities

-Learning Circles

- ***"consciously and proactively structured groups organized primarily to promote learning"***

Critical Conditions for LCs & lcs

1. Building community
2. Constructing knowledge
3. Supporting learners
4. Documenting reflection
5. Assessing expectations
6. Changing cultures

Collay et al. (1998)

Communities of Learners…

- "groups of people gathered together intentionally for the purpose of supporting each other and the process of learning…
- Learning Circles

  "smaller groups of learners within the larger group or community… where there is a more personal forum for professional interaction and greater opportunity for conversations [dialog]… where members can construct ideas together.. share opinions.. debate issues"

Collay et al. (1998)

Members

- Take responsibility
- Make choices and decisions
- Agree on a agenda with leaders

Professional Cultures
for
Faculty & Students

1. Shared decision-making
2. Shared sense of purpose
3. Collaborative work towards that purpose
4. Collective responsibility

Learning Communities Require Transformative Communication

- Both senders and receivers of information are changed as they engage in the learning experience

Characteristics of Learning Communities:

- A shared goal, problem or project
- Shared resources
- Shared membership and leadership
- Commitment to improvement of professional practice
- Collaborative approaches to group work
- Learning and development focused on real-world based issues and practice
- Autonomous community members
- High levels of dialogue, interaction and collaboration
- Information and knowledge sharing
- Knowledge constructivism
- Knowledge transfer and knowledge exchange
- Use of information and communication technologies

Lewis and Allan, (2005)

Learning Communities…

- *“ the challenge…to take advantage of LC structure to capture and intensify the synergistic possibilities for meaningful community building and learning…*

  space to bring together theory and practice

Core Practices

- community
- integration
- make meaning

- diversity
- active learning
- reflective assessment

Critical Questions

- Why do we exist?
- What is our fundamental purpose?
- What do we hope to become?
- What do we hope to achieve?
- What are our strategies for becoming better?
- How will we define our expected results reality?
- What criteria will we use to assess our improvement effort?

Communities of Practice

- *"Companies at the forefront of the knowledge economy are succeeding on the basis of communities of practice, whatever they call them…communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, who deepen their knowledge and expertise in this area by interacting on an ongoing basis."*

Wenger, McDermott, and Snyder, (2002)

Characteristics of Communities of Practice

(real world business, industry…organizations)

- common purpose identified by participants
- shared membership and leadership
- participants likely to be at different stages in their professional life
- acceptance of low levels of participation by new members, that is, legitimate peripheral participation
- development, creation and management of knowledge within organizations
- open-ended, not time bound
- importance of dialogue, interaction and shared narratives

Lewis and Allan, (2005)

Teaching – truly, one of the grandest of adventures

Are we the “learned” or the “learning”?

(One experiment after another)

Professionals Who Teach

1. emphasize learning rather than teaching
2. emphasize active student engagement with significant content
3. focus on student performance and production
4. collaborate with colleagues
5. are students (themselves) of teaching and consumers of research
6. function as leaders for “ *every great leader is clearly teaching and every great teacher is leading”*

Learning – *What does it mean?*

- How do I know my students have learned?
- How do I know I’ve learned?

- What provides evidence of their learning?
- What provides evidence of my learning?

Learning requires:

Metanoia

- “meta”- above or beyond + “noia”(nous) – of mind = transcendence of mind

- “a fundamental shift or movement of mind”

- the deeper meaning of learning

(Senge, 1990)

Metanoia

- Through learning we re-create ourselves.
- Through learning we become able to do something we never were able to do [before].
- Through learning we extend our capacity to create, to be part of the generative* process of life.

(Senge, 1990)

Learning **IS NOT** synonymous with "taking in information"

Knowledge

- "… a process, and a relational one at that, which cannot therefore be located simply in a individual head, to be extracted and shared as an organizational asset. Knowledge is the act of conversing. And learning occurs when ways of talking, and therefore patterns of relationship, change…the knowledge assets of an organization lie in the pattern of relationships between its members"

Stacey (2001)

Learning is **NOT**!

Static

- Listening, memorizing, and then repeating what we recalled
- Where we provide learners with the answers rather then the questions and problems…

Dynamic

★ Society, real world, requires learners to actively plan, observe, test, and reflect, rather than the passive approach above.

★ Active, inquiry-based, learning puts the burden of learning on the learner to explore the unknown

Thomas et al, (2005)

Shift of mind leads one:

- from…
  - Seeing ourselves as separate from the world
- to…
  - Connected to the world
- to…
  - Transforming the world
- to…
  - Creating the world

(Senge, 1990, 2000)

Assumptions

Learning :

- Inquires into underlying assumptions and deepens the learning process
- Is an active process that occurs over time
- Is driven by the learner around meaningful issues
- Is experimental by nature

Wald and Castleberry, (2000)

Professionals Construct Self Knowledge

- **learning is an active process requiring involvement of the learner. Knowledge cannot simply be transmitted. For learning to take place, professionals must be motivated to learn and have an active role in determining the direction and progress of learning. Meaningful problems engage people in learning.**

- learning must acknowledge and build on prior experiences and knowledge. Accordingly, professionals need opportunities to explore, articulate, and represent their own ideas and knowledge

- learners construct knowledge through experience. Opportunities to observe and assess actions and to develop and test new ideas facilitate behavioral change.

- learning is more effective when it takes place as a collaborative rather than an isolated activity and in a context relevant to the learner.

Osterman and Kottkamp, (2004)

Knowledge Community Beliefs

- Knowledge lies less in its database than in its people
- (For all information's independence and extent,)
  it is people, in their communities, organizations, and institutions ultimately
- [who] Decide what it all means and why it matters
  – *the social system-the people, organizations, and institutions involved*
- Knowledge is something we digest rather than merely hold. It entails:
  – *the knower's understanding and having some degree of commitment*

Fullan, (2003)

*Generative Learning

"learning that enhances our capacity to create"

(Senge, 1990)

“holding a vision and concurrently telling the truth about the current reality relative to that vision”

Results in →

– Individuals influencing their reality

(Senge, 1990; Martin Luther King Jr., 1986; Socrates, ?)

- Deep down we are all learners
- We hunger for… and love to… learn

(Senge, 1990)

Transformative Learning

– grants the power to relate to the subject mater

– builds upon existing knowledge

– constructs new knowledge

– empowers one to create their desired future

(Senge, 2000)

Pedagogy

– **Transmission Pedagogy**– takes power away from the learner and the teacher

– **Generative Pedagogy** – grants the power to relate to the subject matter and build on existing knowledge for both the teacher and the learner

– **Transformative Pedagogy** – grants the power to create one's desired future for both teachers and learners

(Senge, 2000)

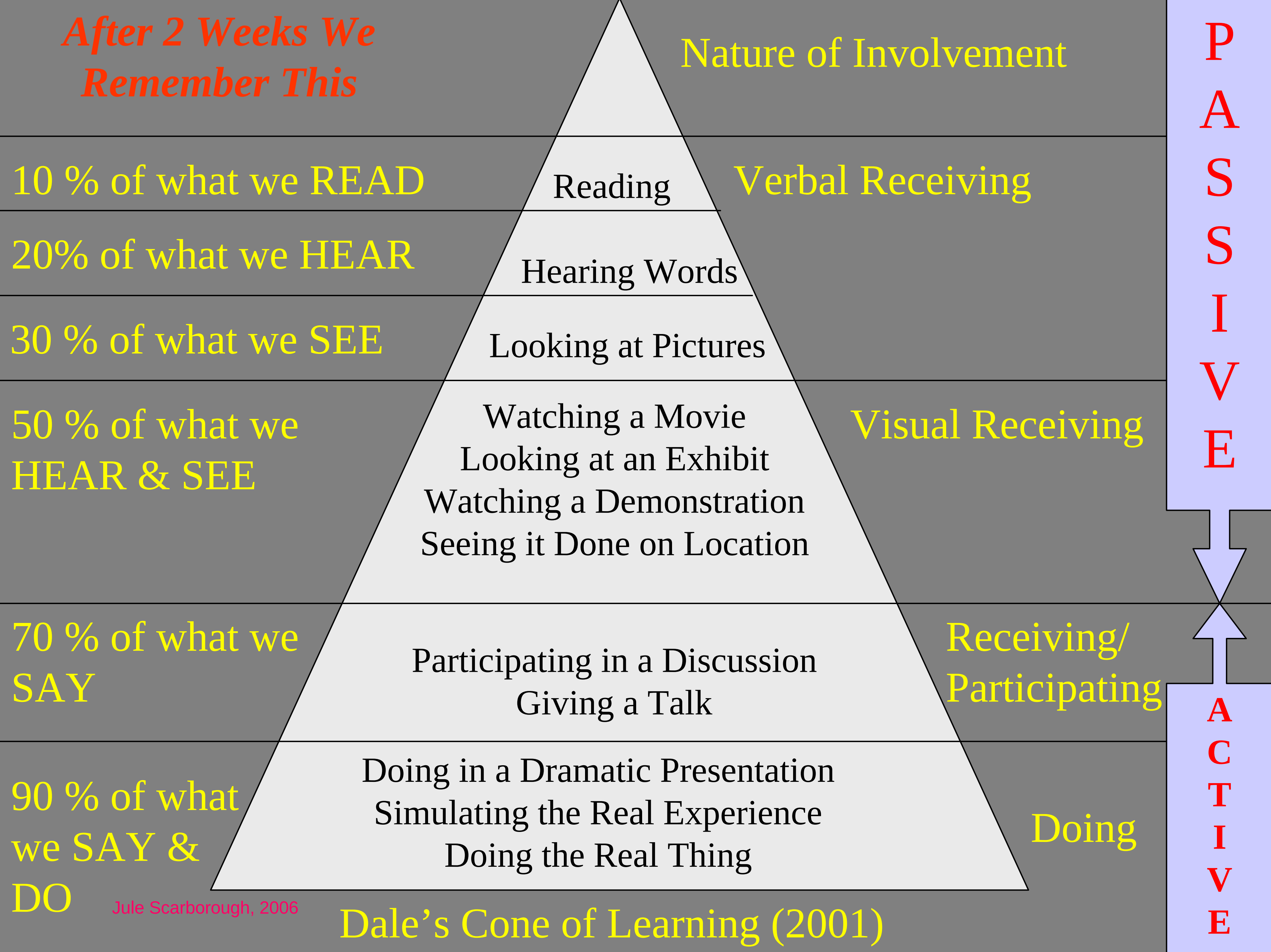
Learning…

– begins with a question

– requires openness about

and

– comfort with "not knowing"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50 % of what we HEAR & SEE
Watching a Movie
Looking at an Exhibit
Watching a Demonstration
Seeing it Done on Location
Visual Receiving
70 % of what we SAY
Participating in a Discussion
Giving a Talk
Receiving/ Participating
90 % of what we SAY & DO
Doing in a Dramatic Presentation
Simulating the Real Experience
Doing the Real Thing
Doing
PASSIVE
ACTIVE
Jule Scarborough, 2006
Dale's Cone of Learning (2001)

Jule Scarborough, 2006

Bloom's Taxonomy of Learning

"Levels"

Bloom, (1956)

Evaluation

-students make critical judgments about relative worth of ideas, products & positions as they take positions & justify

Synthesis

-students exploit their mastery of concepts to create new and original products, ideas and/or solutions

Analysis

-students take apart concepts, ideas and/or products in order to identify patterns & relationships

Application

-students are able to exploit their understanding of factual material to solve problems and design and make products

Comprehension

-students make sense of factual material and are able to employ this understanding to represent the information in a variety of media and or genres

Knowledge

-students engage factual material and able to recall and describe facts


Dale's
Cone of Learning
(2001)
Reading
Hearing Words
Looking At Pictures
Watching A Movie
Looking At An Exhibit
Watching A Demonstration
Seeing It Done On Location
Participating In A Discussion
Giving A Talk
Doing Dramatic Presentation
Simulating The Real Experience
Doing The Real Thing
K
K
C
C
C
AASE
Active and we
learn 90%
Bloom,
Taxonomy of
Learning
Bloom, (1956)
Jule Scarborough, 2006

Bloom's Revised Taxonomy of Learning

Anderson & Krathwohl, (2001)

The Knowledge Dimension	The Cognitive Process Dimension					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Meta-Cognitive Knowledge						

Self-assessment

- Does our teaching have purpose, meaning, focus?

- **Critical Questions:**
  - Do our contents have integrity?
  - Do our measurement strategies and procedures have integrity?
  - Do our teaching processes have integrity?
  - Do our educational products have integrity?
  - Do we as professors have integrity?
  - Do our syllabi have integrity?
  - Are we training or educating?
  - Are we creating a learning community?
  - Do we deliver on "promises?"
  - Are we "transforming leaders" (Burns, 1978)

Do all students have to do the same thing to learn the same thing?

Don’t forget to ask your students…

Student Learning Communities (Teams) Technology 496

Jule Scarborough, 2006

Jule Scarborough, 2006

Jule Scarborough, 2006

Jule Scarborough, 2006


Jule Scarborough, 2006

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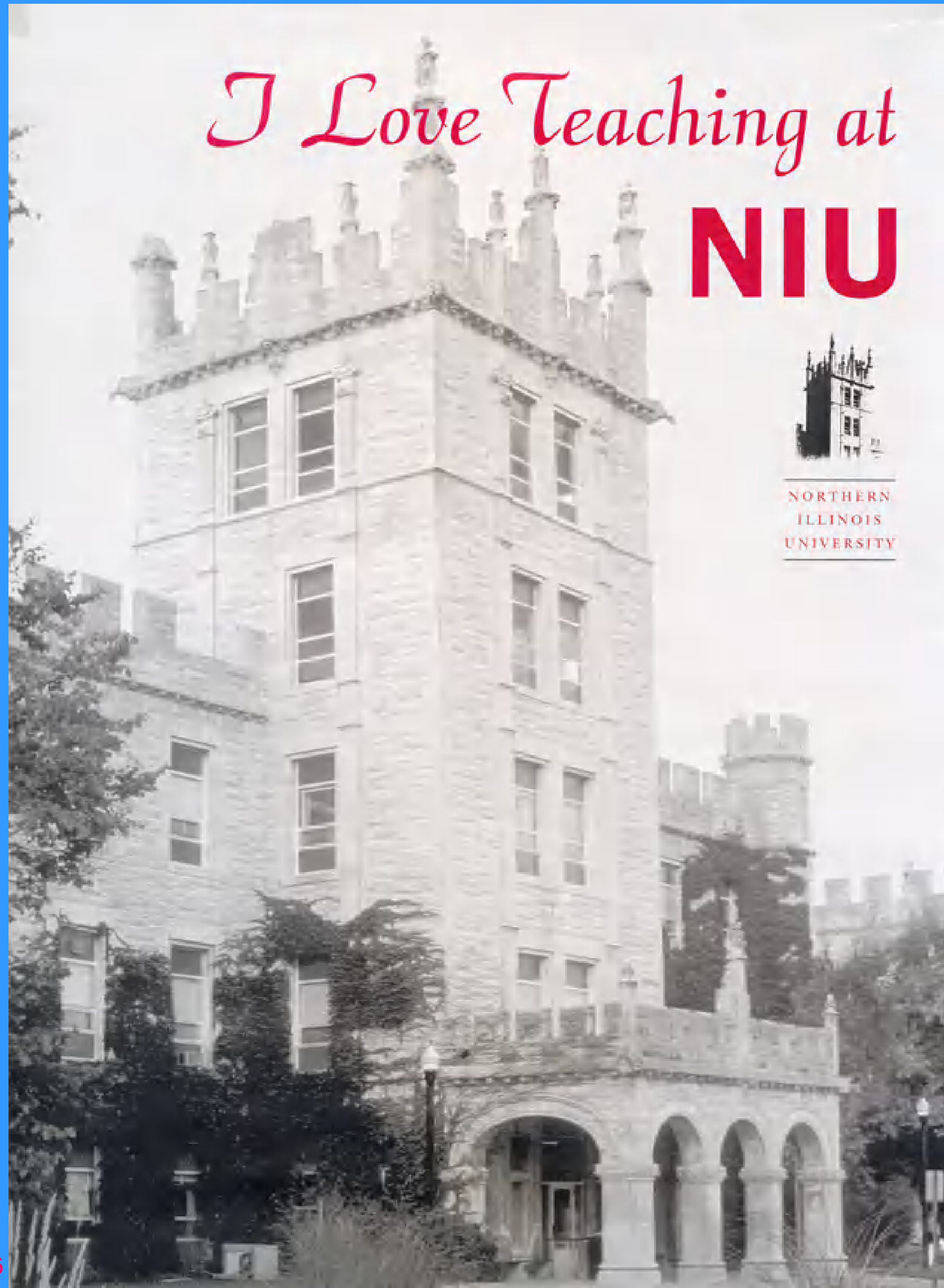
Assessment
Jule Scarborough, 2006



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Community of Practice Partners

- NIU Professional Staff, Operations Engineers

- NIU Athletics

- Regional Business and Industry

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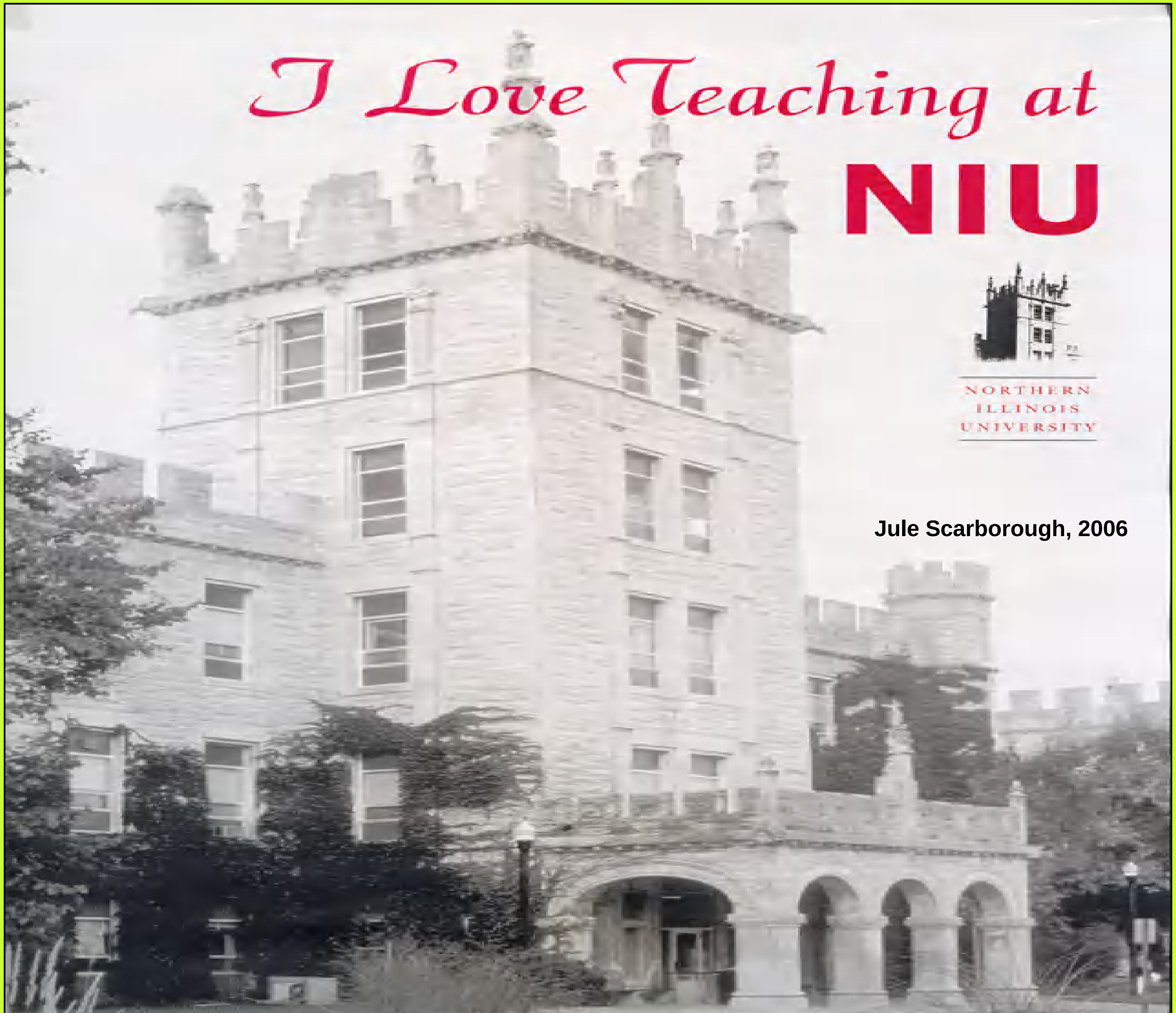


Student Learning Outcomes

(for PowerPoint presentations, contact julescarborough@niu.edu)

Student Learning Outcomes

The Terminology and History

Jule Scarborough, 2006

Intentional Instructional Design

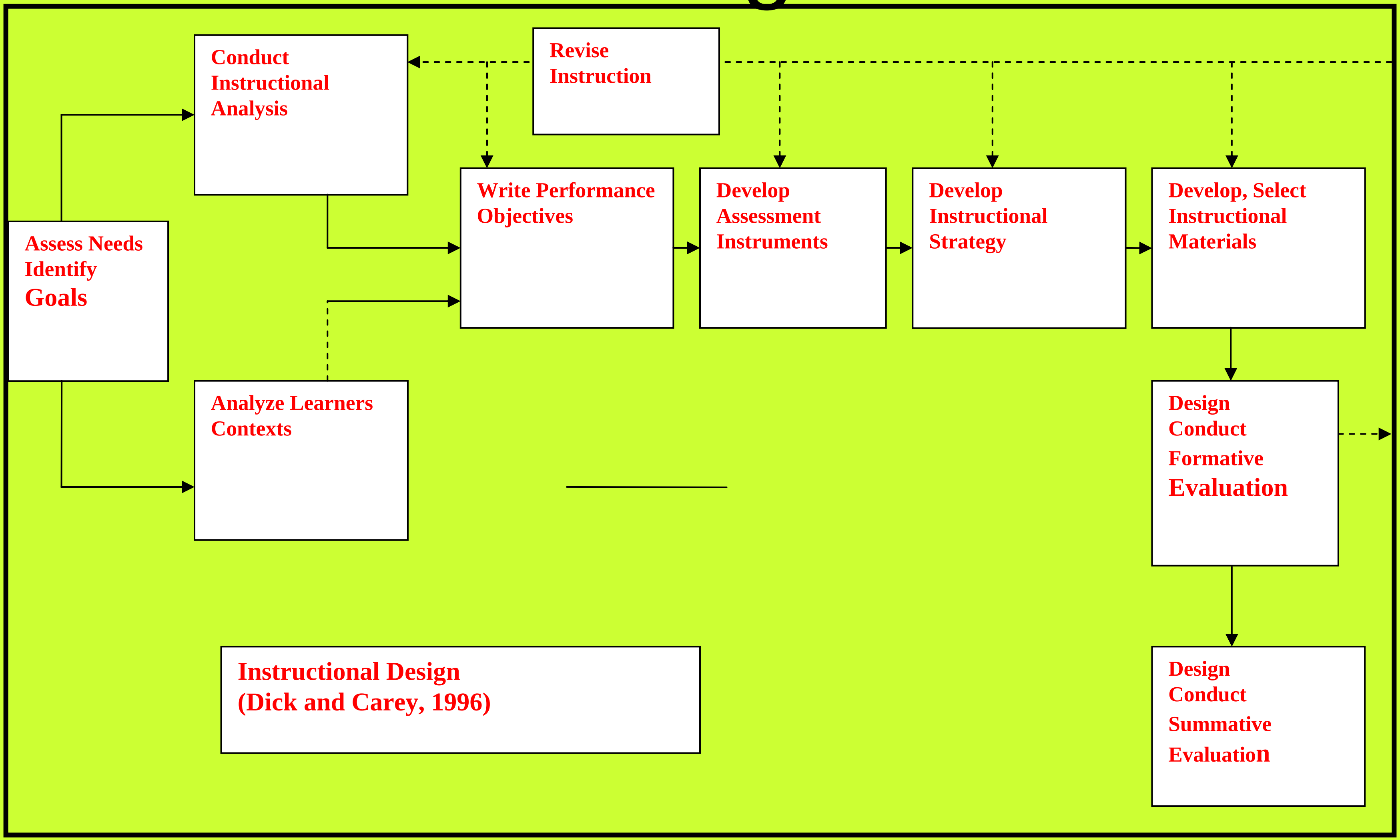
Reversed Design Process

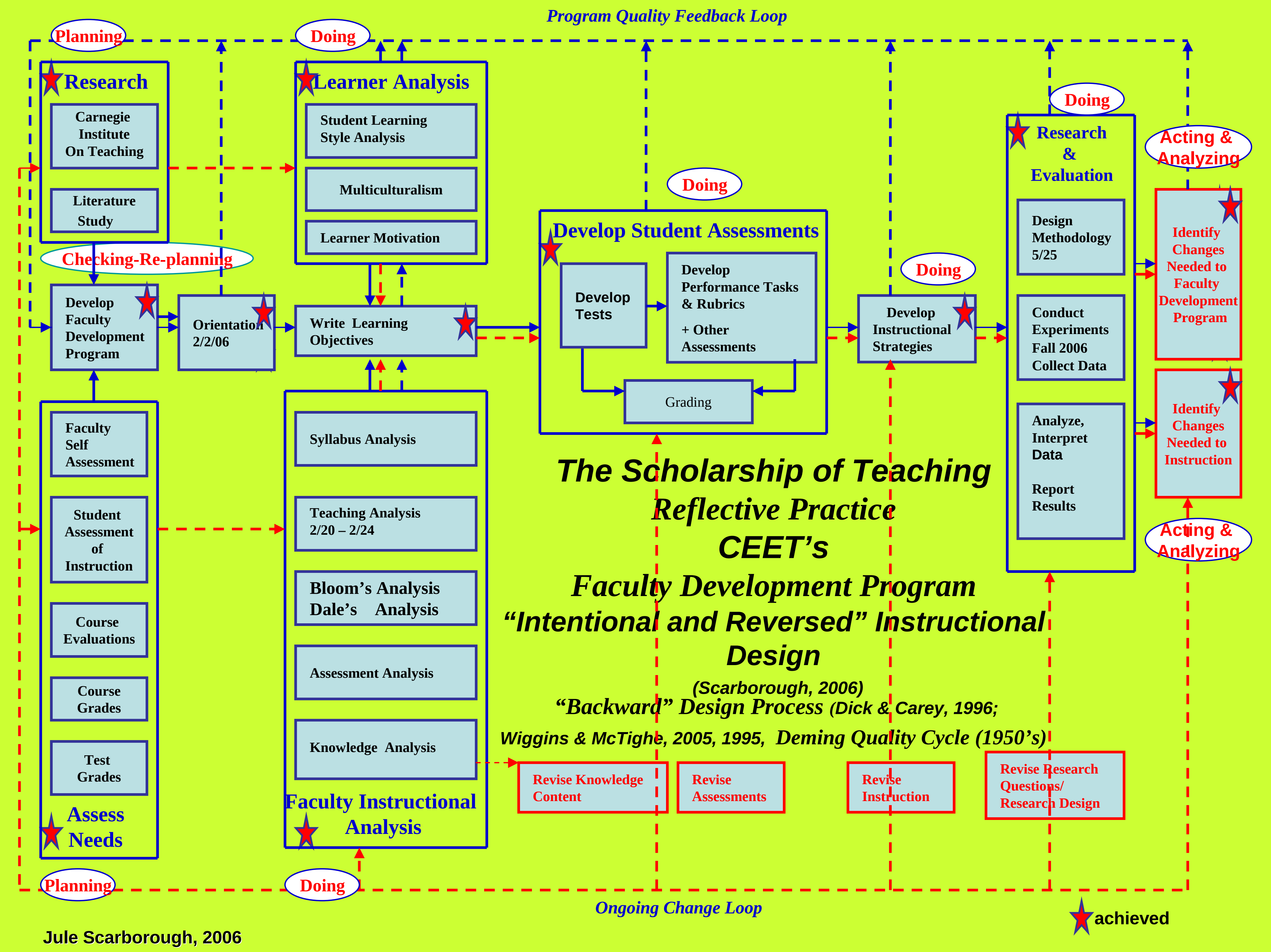
What do you want students to know?
What do you want students to be able to do?

What is acceptable evidence of learning?
How do you want students to provide evidence of learning?

Dick and Carey, 1996
Wiggins and McTighe, 2005

Systematic Instructional Design





Program Quality Feedback Loop
Planning
Doing
Research
Carnegie Institute On Teaching
Literature Study
Learner Analysis
Student Learning Style Analysis
Multiculturalism
Learner Motivation
Doing
Develop Student Assessments
Develop Tests
Develop Performance Tasks & Rubrics
+ Other Assessments
Grading
Doing
Research & Evaluation
Design Methodology 5/25
Conduct Experiments Fall 2006 Collect Data
Analyze, Interpret Data
Report Results
Acting & Analyzing
Identify Changes Needed to Faculty Development Program
Identify Changes Needed to Instruction
Acting & Analyzing
Checking-Re-planning
Develop Faculty Development Program
Orientation 2/2/06
Write Learning Objectives
Doing
Develop Instructional Strategies
Faculty Self Assessment
Student Assessment of Instruction
Course Evaluations
Course Grades
Test Grades
Assess Needs
Syllabus Analysis
Teaching Analysis 2/20 – 2/24
Bloom's Analysis
Dale's Analysis
Assessment Analysis
Knowledge Analysis
Faculty Instructional Analysis
The Scholarship of Teaching
Reflective Practice
CEET's
Faculty Development Program
"Intentional and Reversed" Instructional Design
(Scarborough, 2006)
"Backward" Design Process (Dick & Carey, 1996;
Wiggins & McTighe, 2005, 1995, Deming Quality Cycle (1950's)
Revise Knowledge Content
Revise Assessments
Revise Instruction
Revise Research Questions/ Research Design
Planning
Doing
Ongoing Change Loop
achieved
Jule Scarborough, 2006

Student Learning Objectives or Outcomes

Objectives should be STUDENT-CENTERED

students will be able to demonstrate what they know or can do

Hernon et al 2004, p.48

Terminology and Meanings

- Behavioral Objectives?
- Course Objectives?
- Student Learning Objectives?
- Learning Goals?

- NOW WHAT!?……Are these terms interchangeable?

- Student Learning Outcomes???

(**See**: Joanna Allan "*Learning Outcomes in Higher Education*". Studies in Higher Education, Vol. 21, No.1, 1996, pp.93-107)

Student Learning Objectives or Outcomes

embedded within the broader standards and goals of the accreditation or educational agencies, university, and programs

Results Oriented

outcomes of learning can be observed and measured

Learning Expectations

- Specificity **increases** at each level
- Upper level goals, e.g. ***institutional/agency establish*** areas of expected knowledge or skill (do not specify discipline, conditions, learning level)
- ***Student*** learning objective or outcome, ***most specific*** level (should specify discipline, conditions, learning levels)

Specificity of Objectives
A Continuum

- **Global** – broad, complex, multifaceted learning outcomes that require time and instruction to accomplish, e.g. “excite the imagination”

- **Educational** – more focused, delimited “the ability to read musical scores”

- **Instructional** – focused on monthly, weekly, day to day “slices” of learning, fairly specific in content, e.g. “able to differentiate among four international business theories”

Anderson & Krathwohl (2001)

Accreditation Standards & State Board of Higher Education Goals
(Global)

NIU General Education Goals
(Global)

College and Departmental Program Goals
(Educational –discipline or sub-discipline)

Course Objectives
(Instructional -conditions, constraints, levels of learning)

Student Learning Objectives
& Outcomes

Jule Scarborough, 2006

Examples

Institutional (global) learning outcomes:

Students will be capable of:

analysis, problem solving, communicating, decision-making; will have a global perspective, be capable of social interaction, etc.

Students will be capable of: reading, writing, reasoning, acquiring knowledge, etc.

What Objectives are NOT!

Means vs. Ends

Ends: objectives describe "ends" – intended results, outcomes, changes in students

Means to the End: instructional activities, e.g. reading the text book, listening to the professor, conducting an experiment, going on a fieldtrip

Anderson & Krathwohl (2001)

Jule Scarborough, 2006

Relationship of Global, Educational, and Instructional Objectives

	Level of Objective		
	Global	Educational	Instructional
Scope	**Broad**	**Moderate**	**Narrow**
Time Needed	**One or more years (often many)**	**Weeks or months**	**Hours or days or weeks**
Purpose or Function	**Provide vision**	**Design curriculum**	**Prepare lesson plans**
Example of Use **Anderson & Krathwohl (2001)**	**Plan a multiyear curriculum, <u>B.S. degree</u> in Technology or B.S. in Engineering**	**Plan units of instruction, <u>Course</u> in General Ed., B.S. in Engineering or Technology**	**Plan monthly, weekly, <u>daily</u> activities, experiences, and <u>exercises</u> in a <u>course</u>** **Jule Scarborough, 2006**

Planning Student Learning

Desired Outcome	Methods of Assessment	Level of Assessment	Strategy	Recommendations	Changes in Learning
What knowledge, abilities, or skills should students exhibit? Competencies? What level of competency do I expect of them?	What evidence of learning will be required? Is it **direct** or indirect? Which method? Why?	Is assessment at the institutional program, or course level? What levels of learning will be required? Are there options?	How will students be given the opportunity to gain that knowledge or skill?	Based on the evidence gathered, what are the suggestions for improving student learning?	What resulted from implementation of the recommendations?
Anderson & Krathwohl (2001)	Test Performances Others	Example: Layered Curriculum→ Choices A-C	Lecture Text Other Methods	Based upon how well my student learned, what am I going to change to increase student learning the next time?	Did students learn at higher levels? Were they more competent?

Jule Scarborough, 2006

"Backward" Instructional Design Model

Identify desired results

Determine acceptable evidence

Plan learning experiences and instruction

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Wiggins & McTighe (1995)

Program Research Outcome & Embedded Competencies

To apply relevant research to problem-centered course assignments.

1. Analyze a problem in its **full** complexity.

2. Identify and relate **relevant** literature to the problem under investigation.

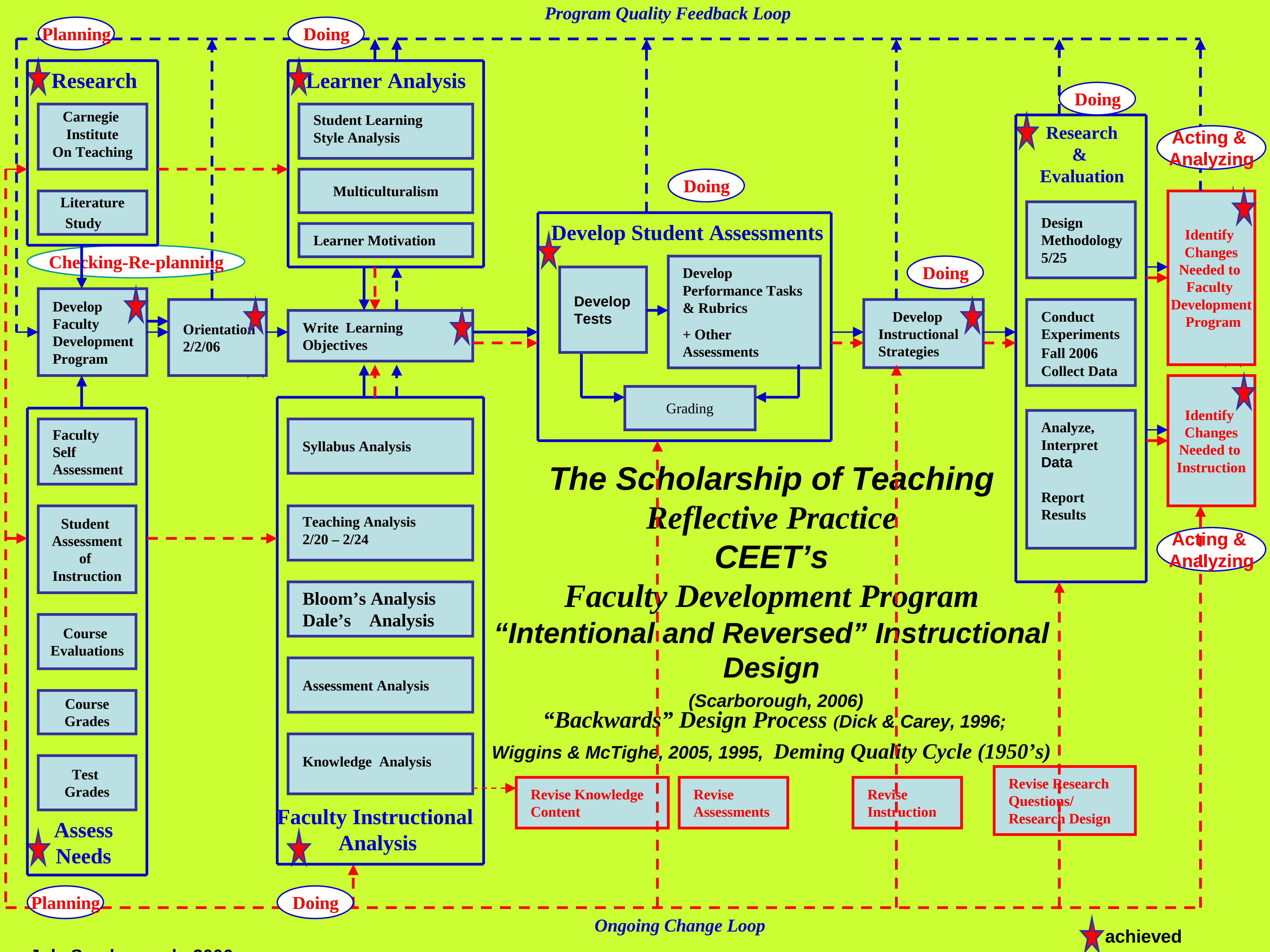
3. Select or develop **a** theoretical framework appropriate to solving that problem.

4. Select an **appropriate** procedure (research design and methodologies) that addresses study objectives, research questions, and hypotheses.

5. Adopt **appropriate** indicators of reliability and validity.

6. Demonstrate **effective** written, oral, and presentation skills to convey study findings and how those findings match the stated problem statement.

Hernon 04,p.304



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Learning Objective

"pre-formulated specific goal" - educational <u>intent</u> or goal of learning – what the professor "intends" to teach and student should learn (Eisner, 1979,p.103)

measurable, achievable, tangible, observable product of learning which is capable of being specified in advance

terms that identify both the behaviour to be developed and the content within which this behaviour is to operate

"*to write clear and well-organized fuel cell research reports*"

NOT

topics, content, and concepts; these <u>fail to indicate what students are expected to do</u> with the content; does not specify what is supposed to ensure from learning experience (e.g. course outlines generally part of a course syllabus).

Behavioral Objective

kinds of changes in behaviour (thinking, feeling, action) that an institution seeks to bring about in its students (including conditions and standards-Mager, 1962)

"to be able to to write a musical composition with a single tonal base within four hours. The composition must be at least 16 hours long and must contain at least twenty-four notes. You must apply at least 3 rules of good composition in the development of your score" [performance task]

(Eisner, 1979)

Behavioral Objective

- To state an objective that will successfully communicate your educational intent, you will sometimes have to **define terminal behavior further by stating the conditions you will impose** upon the learner when he/she is demonstrating mastery of the objective, what he/she is to do or perform while demonstrating mastery:

“**Given a standard set of tools….”**

“Given a matrix of intercorrelations…”

“Given a linear algebraic equation with one unknown, the learner must be able to solve for the unknown without the aid of references, tables, or calculating devices.”

Learning Outcome

“essentially what one ends up with, intended or not, after some form of engagement” [learning event]

what the student achieves; consequences of learning experiences
(Eisner, 1979, p.103)

should be subject-specific content and context

“that on completion of the research methods module, the student will be able to apply knowledge of validity, reliability and triangulation to a chosen research issue.”

(shows what the student will be able to do as a result of learning experiences that have been planned)

“what learners know and/or can do as a result of learning” (Otter 1992, p.i)
[know about vs.know]

Verbs

- **Words open to many interpretations:**

To know
To understand
To really understand
To appreciate
To fully appreciate
To grasp the significance of
To enjoy
To believe
To have faith in

- **Words open to fewer interpretations:**

- To write
- To recite
- To identify
- To differentiate
- To solve
- To construct
- To list
- To compare
- To contrast

Jule Scarborough, 2006

Standards

- Statements about what students are expected to learn…

- “essential skills”
- “learning expectations”
- “learning outcomes”
- “achievement expectations”
- “other names

(Nitko, 2004)

Content vs. Knowledge

Content:

subject matter content or content domain

matter dealt with in a field

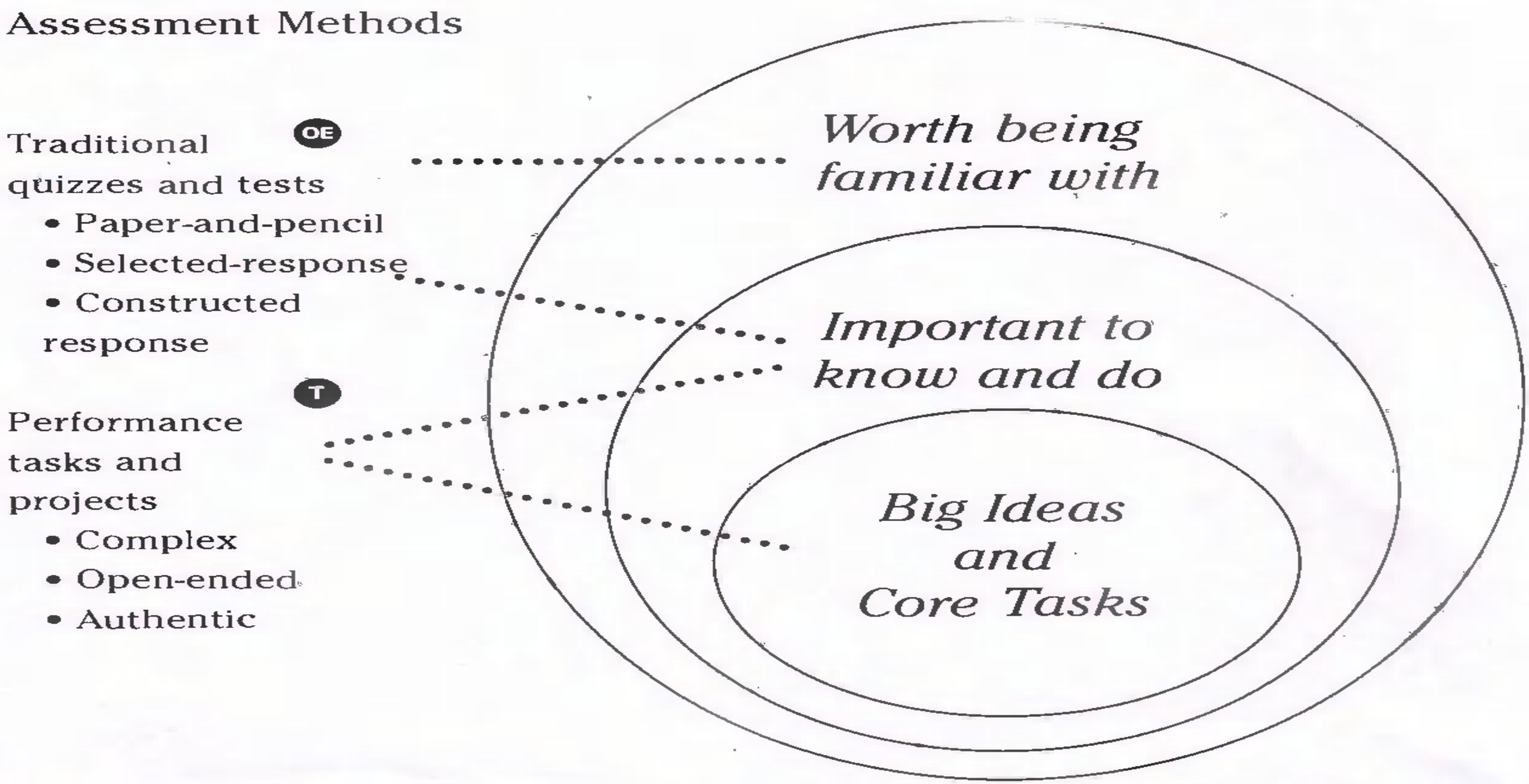
substance

Who determines the "content substance"?

"those scholars who have spent their lives studying and working in a field, e.g. mathematics, engineers, etc. – shared knowledge" Over time, they share, change, extend knowledge through interaction throughout the scholarly community; fields are not static, rather dynamic as changes are made when new idea and evidence are generated… **Anderson & Krathwohl (2001)**

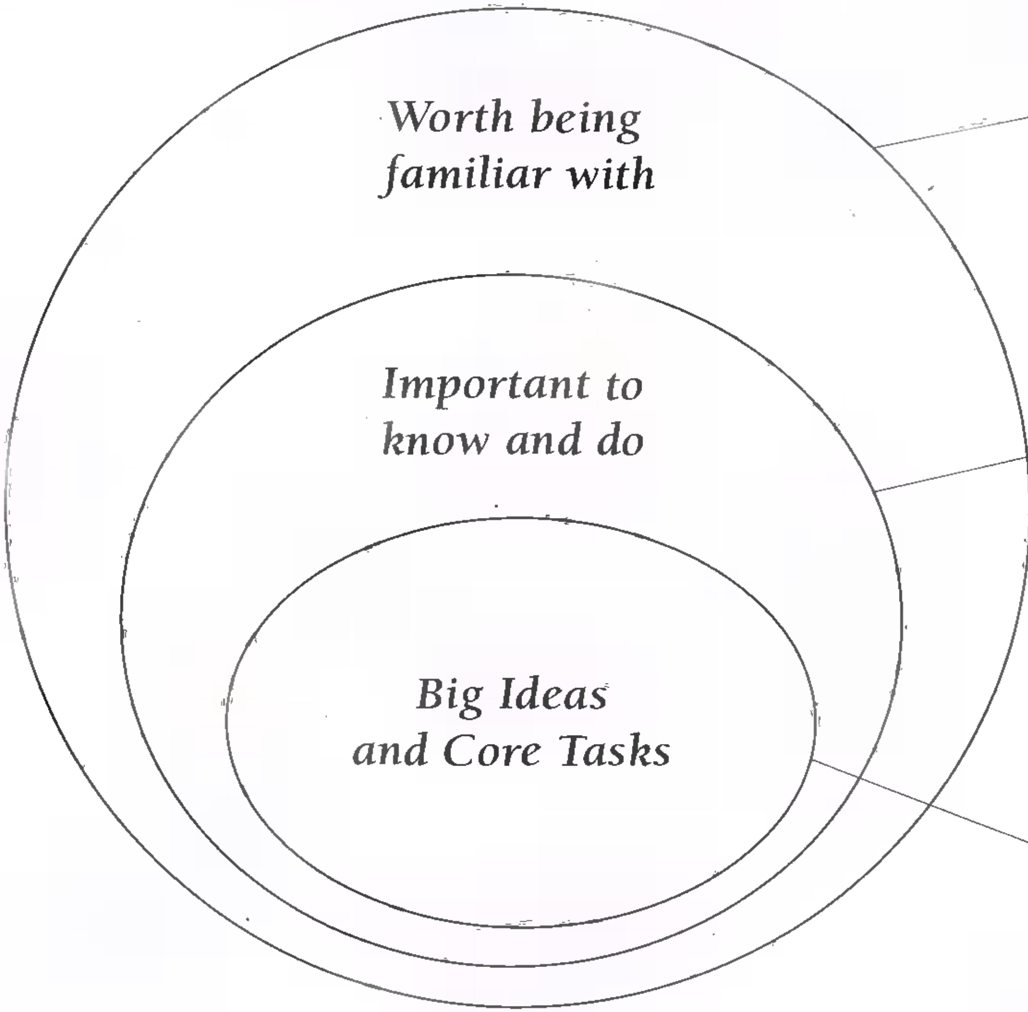
Fig. 7.11 Curricular Priorities & Assessment Methods

In effective assessments, we see a match between the type or format of the assessment and the needed evidence of achieving the desired results. If the goal is for students to learn basic facts and skills, then paper-and-pencil tests and quizzes generally provide adequate and efficient measures. However, when the goal is deep understanding, we rely on more complex performances to determine whether our goal has been reached. The graphic below reveals the general relationship between assessment types and the evidence they provide for different curriculum targets.



Wiggins & McTighe (2005) p. 170

Fig. 3.3 Clarifying Content Priorities



Familiar with

- Key figures who contributed to the development of modern statistics (Blaise Pascal and Lewis Terman)
- All nonessential terminology, for example, interquartile range (no need to be able to define these)

Important to know and do K S

- Measures of central tendency: mean, median, mode, range, standard deviation
- Data displays: bar graph, line plot, box and whiskers plot, stem and leaf plot
- Various statistical formulae and techniques

Big Ideas U

- "Average," range, degrees of confidence, lying with statistics, valid model, reliable data

Big Ideas framed as Understandings

- Statistical analysis often reveals patterns that prove useful or meaningful
- Statistics can conceal as well as reveal
- Abstract ideas, such as fairness, can be modeled statistically

Core Tasks

- Choosing the appropriate measure of central tendency in various real-world situations
- Critique of real-world statistical analyses and misleading graphs

Wiggins & McTighe (2005) p. 71

Knowledge vs. Subject Matter Content

Knowledge – disciplinary subject matter, e.g. concepts, principles, facts, theories in an academic discipline

Subject Matter Content – materials used to convey the knowledge and promote learning to the students, "the packaging", e.g. textbooks, courses, multi-media packages – curricular or instructional materials – materials

Anderson & Krathwohl (2001)

Standards

- **<u>Content</u> Standards**

  statements about subject matter facts, concepts, principles, etc.

- **<u>Performance</u> Standards**

  statements about the things students can perform or do once the content is learned

(Nitko, 2004)

KSAs

- **Knowledge (K)**
- **Skills (S)**
- **Abilities (A)**
- **What we are trying to develop in students…**
- **NOT <u>JUST</u> Knowledge and Skills**

Learning Targets

- Standards = Learning Targets
- Goals = Learning Targets
- Objectives = Learning Targets

Specific Learning Targets ➡ **Mastery Learning Targets**

(Nitko, 2004)

Mastery Learning Targets

Statements of what student **can do** at the end of instruction

“Can do” statements “To Verb Noun + ”

(conditions, constraints, etc.)

Also called: “specific learning outcomes”

“behavioral objectives”

(refer to definition above-old expression)

(Nitko, 2004)

Developmental Learning Targets

- Skills and abilities more aptly stated at a somewhat **higher level of abstraction** than mastery learning targets

- **Why?**

- To communicate that they are continuously **developed throughout life.**

(Nitko, 2004)

Examples of Developmental Learning Targets

1. **<u>Analyze</u> and make <u>critical judgments</u> about the viewpoints expressed in passages.**

2. **<u>Write</u> several paragraphs that <u>explain</u> the author's point of view.**

Developmental Objectives

4. **Use numerical concepts and measurements to describe real-world objects.**

5. **Interpret statistical data found in material from a variety of disciplines.**

6. **Write imaginative and creative stories.**

Developmental Objectives

7. <u>Use</u> examples from materials read to support your point of view.

8. <u>Communicate</u> your ideas using visual media such as drawings and figures.

(Nitko, 2004)

Developmental Learning Targets

- They are <u>generic</u>
- No conditions **"lifelong in nature"**
- No constraints
- No specific discipline
- No specified levels of learning

(Nitko, 2004)

Lifelong & Course Specific

- **Need both**
- **Can embed one in the other**

Taxonomies of Learning

- <u>Bloom's</u> Taxonomy of Learning

Domains: <u>Cognitive</u> <u>Affective</u> <u>Psychomotor</u>

<u>Cognitive</u> Domain - knowledge, skills, and abilities requiring memory, thinking, and reasoning

<u>Affective</u> Domain - feelings, interests, attitudes, dispositions, and emotional states

<u>Psychomotor</u> Domain – motor skills and perceptual processes

(Nitko, 2004)

Bloom's Taxonomy of Learning <u>Cognitive</u> Domain

"Levels"

Bloom (1956)

Nitko (2004, p.24-30)

Evaluation

-students make critical judgments about relative worth of ideas, products & positions as they take positions & justify

Synthesis

-students exploit their mastery of concepts to create new and original products, ideas and/or solutions

Analysis

-students take apart concepts, ideas and/or products in order to identify patterns & relationships

Application

-students are able to exploit their understanding of factual material to solve problems and design and make products

Comprehension

-students make sense of factual material and are able to employ this understanding to represent the information in a variety of media and or genres

Knowledge

-students engage factual material and able to recall and describe facts

Jule Scarborough, 2006

Bloom's Revised Taxonomy of Learning

Anderson & Krathwohl, (2001)

The Knowledge Dimension	**The Cognitive Process Dimension**					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Meta-cognitive Knowledge						

Jule Scarborough, 2006

3.2 The Major Types and Subtypes of the Knowledge Dimension*

Major Types and Subtypes	Examples
A. Factual knowledge—The basic elements students must know to be acquainted with a discipline or solve problems in it	
Aa. Knowledge of terminology	Technical vocabulary, musical symbols
Ab. Knowledge of specific details and elements	Major natural resources, reliable sources of information
B. Conceptual knowledge—The interrelationships among the basic elements within a larger structure that enable them to function together	
Ba. Knowledge of classifications and categories	Periods of geological time, forms of business ownership
Bb. Knowledge of principles and generalizations	Pythagorean theorem, law of supply and demand
Bc. Knowledge of theories, models, and structures	Theory of evolution, structure of Congress
C. Procedural knowledge—How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods	
Ca. Knowledge of subject-specific skills and algorithms	Skills used in painting with watercolors, whole-number division algorithm
Cb. Knowledge of subject-specific techniques and methods	Interviewing techniques, scientific method
Cc. Knowledge of criteria for determining when to use appropriate procedures	Criteria used to determine when to apply a procedure involving Newton's second law; criteria used to judge the feasibility of using a particular method to estimate business costs
D. Metacognitive knowledge—Knowledge of cognition in general as well as awareness and knowledge of one's own cognition	
Da. Strategic knowledge	Knowledge of outlining as a means of capturing the structure of a unit of subject matter in a text-book, knowledge of the use of heuristics
Db. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	Knowledge of the types of tests particular teachers administer, knowledge of the cognitive demands of different tasks
Dc. Self-knowledge	Knowledge that critiquing essays is a personal strength, whereas writing essays is a personal weakness; awareness of one's own knowledge level

3.3 The Six Categories of the Cognitive Process Dimension and Related Cognitive Processes*

Process Categories	Cognitive Processes and Examples
1. Remember—Retrieve relevant knowledge from long-term memory.	
1.1 Recognizing	(e.g., Recognize the dates of important events in U.S. history)
1.2 Recalling	(e.g., Recall the dates of important events in U.S. history)
2. Understand—Construct meaning from instructional messages, including oral, written, and graphic communication.	
2.1 Interpreting	(e.g., Paraphrase important speeches and documents)
2.2 Exemplifying	(e.g., Give examples of various artistic painting styles)
2.3 Classifying	(e.g., Classify observed or described cases of mental disorders)
2.4 Summarizing	(e.g., Write a short summary of the events portrayed on videotapes)
2.5 Inferring	(e.g., In learning a foreign language, infer grammatical principles from examples)
2.6 Comparing	(e.g., Compare historical events to contemporary situations)
2.7 Explaining	(e.g., Explain the causes of important eighteenth-century events in France)
3. Apply—Carry out or use a procedure in a given situation.	
3.1 Executing	(e.g., Divide one whole number by another whole number, both with multiple digits)
3.2 Implementing	(e.g., Determine in which situations Newton's second law is appropriate)
4. Analyze—Break material into constituent parts and determine how parts relate to one another and to an overall structure or purpose.	
4.1 Differentiating	(e.g., Distinguish between relevant and irrelevant numbers in a mathematical word problem)
4.2 Organizing	(e.g., Structure evidence in a historical description into evidence for and against a particular historical explanation)
4.3 Attributing	(e.g., Determine the point of view of the author of an essay in terms of his or her political perspective)
5. Evaluate—Make judgments based on criteria and standards.	
5.1 Checking	(e.g., Determine whether a scientist's conclusions follow from observed data)
5.2 Critiquing	(e.g., Judge which of two methods is the best way to solve a given problem)
6. Create—Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure.	
6.1 Generating	(e.g., Generate hypotheses to account for an observed phenomenon)
6.2 Planning	(e.g., Plan a research paper on a given historical topic)
6.3 Producing	(e.g., Build habitats for certain species for certain purposes)

Jule Scarborough, 2006

Categories & Cognitive Processes	Alternative Names	Definitions and Examples
1. Remember—Retrieve relevant knowledge from long-term memory		
1.1 Recognizing	Identifying	Locating knowledge in long-term memory that is consistent with presented material (e.g., Recognize the dates of important events in U.S. history)
1.2 Recalling	Retrieving	Retrieving relevant knowledge from long-term memory (e.g., Recall the dates of important events in U.S. history)
2. Understand—Construct meaning from instructional messages, including oral, written, and graphic communication		
2.1 Interpreting	Clarifying, paraphrasing, representing, translating	Changing from one form of representation (e.g., numerical) to another (e.g., verbal) (e.g., Paraphrase important speeches and documents)
2.2 Exemplifying	Illustrating, instantiating	Finding a specific example or illustration of a concept or principle (e.g., Give examples of various artistic painting styles)
2.3 Classifying	Categorizing, subsuming	Determining that something belongs to a category (e.g., Classify observed or described cases of mental disorders)
2.4 Summarizing	Abstracting, generalizing	Abstracting a general theme or major point(s) (e.g., Write a short summary of the event portrayed on a videotape)
2.5 Inferring	Concluding, extrapolating, interpolating, predicting	Drawing a logical conclusion from presented information (e.g., In learning a foreign language, infer grammatical principles from examples)
2.6 Comparing	Contrasting, mapping, matching	Detecting correspondences between two ideas, objects, and the like (e.g., Compare historical events to contemporary situations)
2.7 Explaining	Constructing models	Constructing a cause-and-effect model of a system (e.g., Explain the causes of important 18th Century events in France)
3. Apply—Carry out or use a procedure in a given situation		
3.1 Executing	Carrying out	Applying a procedure to a familiar task (e.g., Divide one whole number by another whole number, both with multiple digits)
3.2 Implementing	Using	Applying a procedure to an unfamiliar task (e.g., Use Newton's Second Law in situations in which it is appropriate)

5.1 The Cognitive Process Dimension (continued)

Categories & Cognitive Processes	Alternative Names	Definitions and Examples
4. ANALYZE—Break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose		
4.1 DIFFERENTIATING	Discriminating, distinguishing, focusing, selecting	Distinguishing relevant from irrelevant parts or important from unimportant parts of presented material (e.g., Distinguish between relevant and irrelevant numbers in a mathematical word problem)
4.2 ORGANIZING	Finding coherence, integrating, outlining, parsing, structuring	Determining how elements fit or function within a structure (e.g., Structure evidence in a historical description into evidence for and against a particular historical explanation)
4.3 ATTRIBUTING	Deconstructing	Determine a point of view, bias, values, or intent underlying presented material (e.g., Determine the point of view of the author of an essay in terms of his or her political perspective)
5. EVALUATE—Make judgments based on criteria and standards		
5.1 CHECKING	Coordinating, detecting, monitoring, testing	Detecting inconsistencies or fallacies within a process or product; determining whether a process or product has internal consistency; detecting the effectiveness of a procedure as it is being implemented (e.g., Determine if a scientist's conclusions follow from observed data)
5.2 CRITIQUING	Judging	Detecting inconsistencies between a product and external criteria, determining whether a product has external consistency; detecting the appropriateness of a procedure for a given problem (e.g., Judge which of two methods is the best way to solve a given problem)
6. CREATE—Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure		
6.1 GENERATING	Hypothesizing	Coming up with alternative hypotheses based on criteria (e.g., Generate hypotheses to account for an observed phenomenon)
6.2 PLANNING	Designing	Devising a procedure for accomplishing some task (e.g., Plan a research paper on a given historical topic)
6.3 PRODUCING	Constructing	Inventing a product (e.g., Build habitats for a specific purpose)

Others – Nitko, Appendix D & E pp. 460-467

- **Bloom** et al
- Gagne'
- Quellmalz
- **Anderson & Krathwohl**, et al (Revised Bloom)
- Harrow

- **Categories of Learning Targets Derived from the Dimensions of Learning Model (pp.467-469)**

(Nitko, 2004)

Learning Taxonomies

- **Don't *teach* to them**

- **They are NOT teaching hierarchies**

- **Purpose: to <u>classify</u> learning targets**
  to <u>classify</u> assessment tasks

(Nitko, 2004)

Learning Taxonomies

For example, you should NOT:

…teach “knowledge” first,

…teach “comprehension” second

…teach “application” third, etc.

(Nitko, 2004)

Objectives and Outcomes

What is the intended meaning of an objective?

Do they represent ? ….

Learning **OR** **Performance?**

Assessed student performance is used to make inferences about intended student learning.*

***The more specific an objective, the easier it is to assess!**

Some Best Practices

- **Benchmarking**

  Compare your courses against others, national colleagues, for content, teaching models and styles, student assessments, learning experiences, etc.

- **Content Validity Checks**

  Send your course syllabi out to individuals in related communities of practice, e.g. business, industry, hospitals, employers of your students

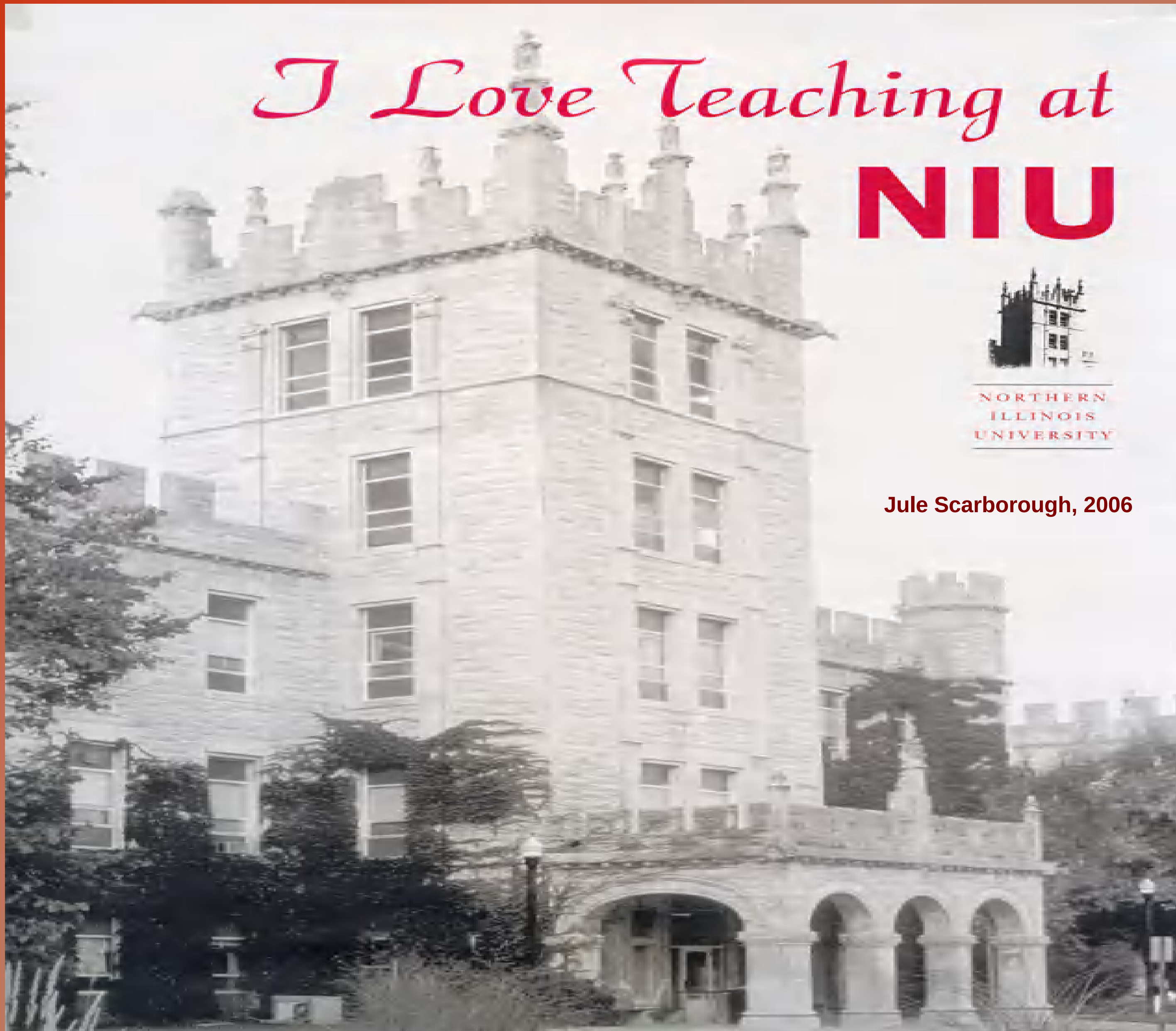
- **Authenticity Checks**

  Check course knowledge content, student assessments against those in the real world communities of practice

- **Continuous Improvements**

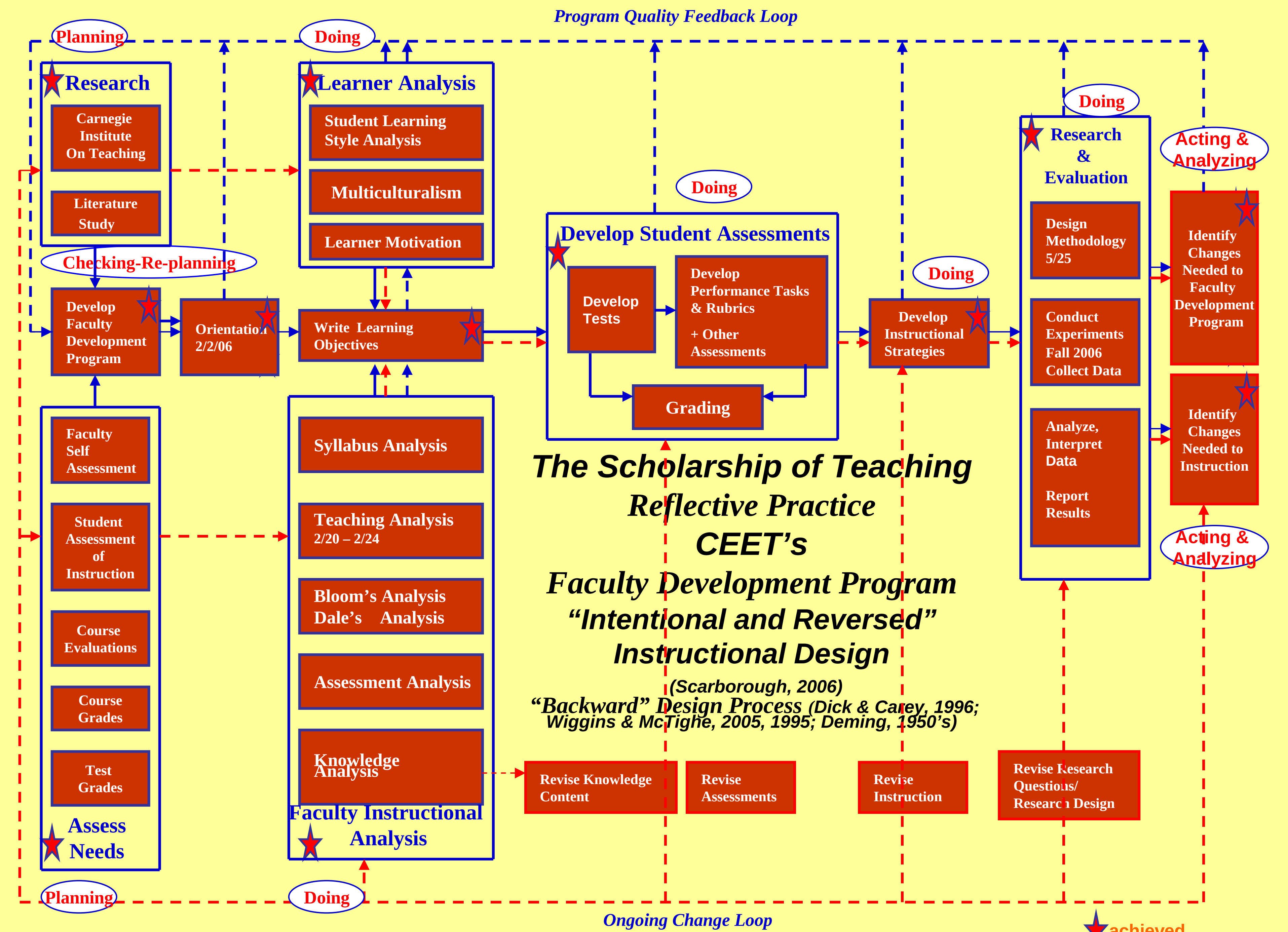
  Close the loop with each course, each semester; consider course outcomes achieved, those not achieved as well as desired; identify needed or desired changes; incorporate changes – that closes the feedback and change loop. Try again.

Jule Scarborough, 2006



Student Assessment

(for PowerPoint presentations, contact julescarborough@niu.edu)



Jule Scarborough, 2006

Assessment and the Improvement of Undergraduate Education

- Quality begins with an organization culture values:
  1. High expectations
  2. Respect for diverse talents and learning styles
  3. Emphasis on the early years of study

- A quality curriculum requires
- coherence in learning:
  4. Synthesizing experiences
  5. Ongoing practice of learned skills
  6. Integration of education and experience

Assessment and the Improvement of Undergraduate Education

- Quality instruction builds in:
  8. Active learning
  9. Assessment and prompt feedback
  10. Collaboration
  11. Adequate time on task
  12. Out-of-class contact with faculty

(Education Commission of the States, 1995, 1996)

9 Principles of Good Practice for Assessing Student Learning

1. The assessment of student learning begins with educational values.

2. Assessment is most effective when it reflects an understanding of learning as multi-dimensional, integrated, and revealed in performance over time.

3. Assessment works best when the program it seeks to improve has clear, explicitly stated purposes.

4. Assessment requires attention to outcomes, but also, and equally to the experiences that lead to those outcomes.

5. Assessment works best when it is ongoing, not episodic

(Education Commission of the States, 1995, 1996)

9 Principles of Good Practice for Assessing Student Learning

6. **Assessment fosters wider improvement when representatives from across the educational community are involved.**

7. **Assessment makes a difference when it begins with issues of use and illuminates questions that people really care about.**

8. **Assessment is most likely to lead to improvement when it is part of a larger set of conditions that promote change.**

9. **Through assessment, educators meet responsibilities to students and to the public.**

What is Assessment?

- Process of gathering information about what students know or can do…
- Key Question: How can we find out what students are learning?
  - We can observe students as they learn
  - We can examine things that students produce

Why Do Assessment?

- Determine student accomplishments
- Gather data for evaluation (i.e. grades)
- Improve instruction
- Address demand for accountability

Balanced Assessment

- **Uses a <u>variety</u> of assessment tools consisting of traditional "tests" and newer "authentic" performance oriented approaches**

- **Each assessment targets specific features that are <u>relevant</u> to the total education program**

- **Assessments are "balanced" in such a way that the <u>strengths</u> of one offset the <u>limitations</u> of another**

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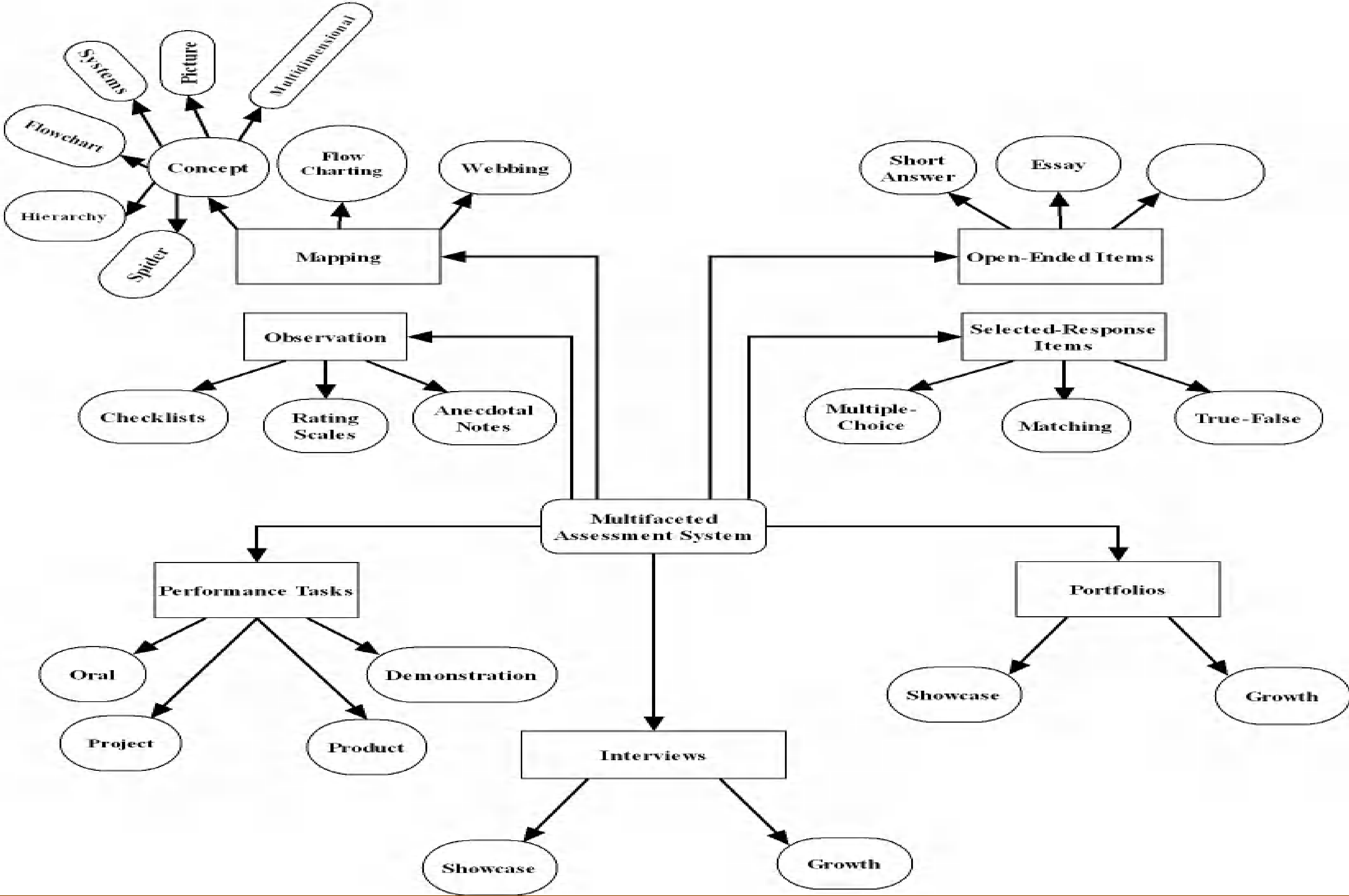
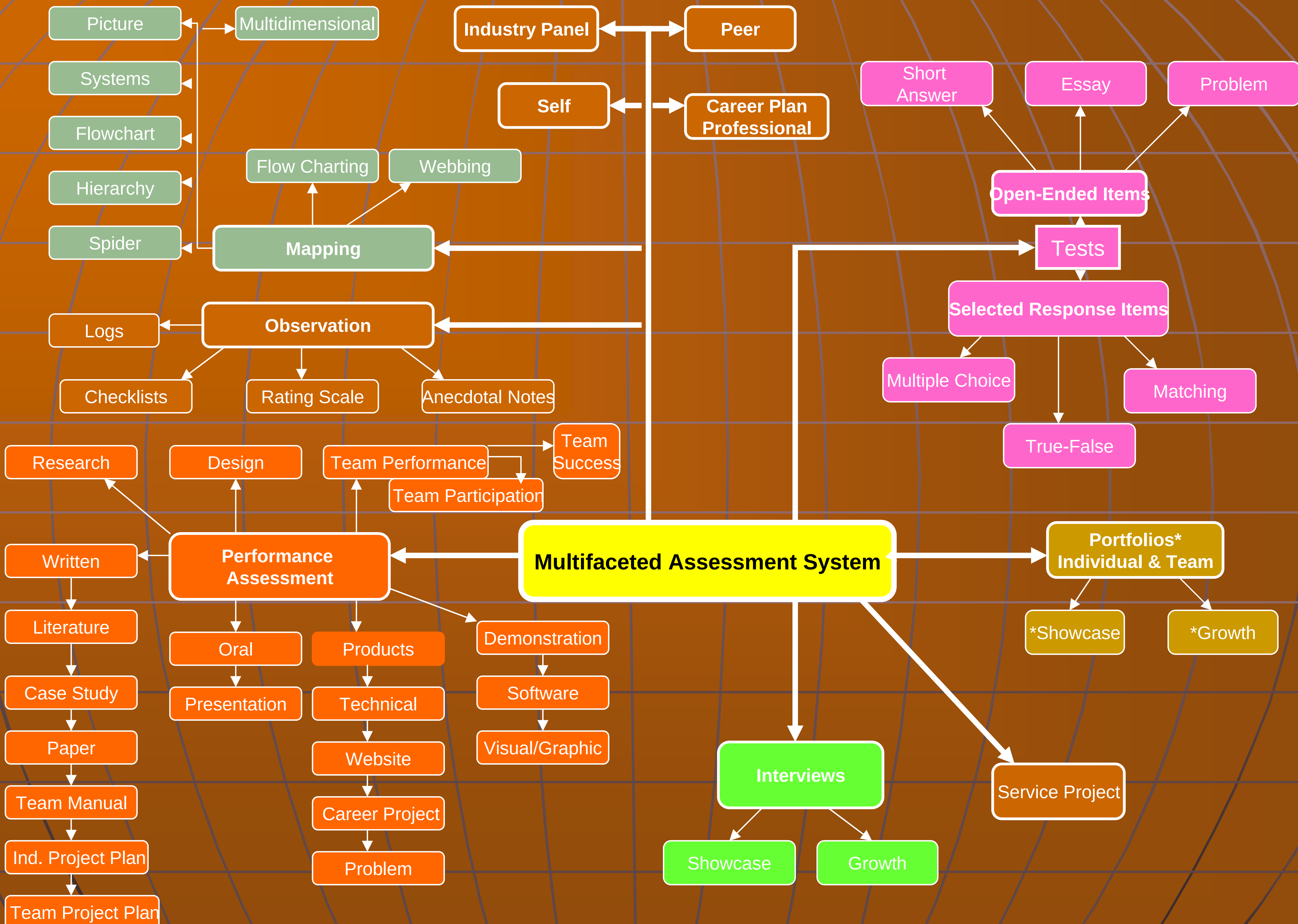
Balanced Assessment

- Traditional Assessment
  - Teacher-made tests for grades and ranking
- Portfolio Assessment
  - Collection of student work for growth and development
- Performance Assessment
  - Authentic assessment of final products or performances

Fig. 12.1 Multifaceted Assessment System



Kuhs et al (2001) p. 157



Scarborough, 2006 – Tech 496 (based upon Kuhs et al, 2001, p.157)

Traditional Assessment

- True-False
- Matching
- Multiple-Choice
- Completion
- Essay

Portfolio Assessment

- Self-Assessment and monitoring of learning
- Document attainment of standards
- Chronicle student growth and development
- Allows integration across subject areas
- Provides a communication vehicle between students, professors, and others

Jule Scarborough, 2006

Performance Assessment

- Mirrors "real life" activities outside the classroom, in the work world…Communities of Practice
- Is worthwhile, significant, and meaningful to students, because it is relevant
- Looks and feels like learning activities rather than tests-not artificial, time-out…because it is integrated and inherent within the learning process
- Involves higher-order thinking skills

Jule Scarborough, 2006

How does Assessment differ from Evaluation?

- **Key Point:** Evaluation is the process of interpreting and making value judgments about assessment information, resulting in:
  - teacher evaluation
  - curricular evaluation
  - instructional evaluation
  - students grades

Assessment

- Purpose: On-going feedback for improving learning <u>and</u> instruction

Evaluation

- Purpose: Summative Judgment

Terminal Judgement

Student Asssessment

WHAT do we want to assess?

HOW do we want to assess?

WHAT type **evidence** of learning is desired?

WHAT do **grades** mean?

Metanoia

- Through learning we re-create ourselves.
- Through learning we become able to do something we never were able to do [before].
- Through learning we extend our capacity to create, to be part of the generative* process of life.

(Senge, 1990)

Learning IS NOT synonymous with "taking in information"

Jule Scarborough, 2006

Learning = Shift of Mind=

Metanoia

- From seeing ourselves …
- as Separate from the world
- to…Connected to the world
- to…Transforming the world
- to…Creating the world

(Senge, 1990, 2000)

*Generative Learning

“learning that enhances our capacity to create”

(Senge, 1990)

Transformative Learning

- **Grants the power …**
  - **To Relate** to the subject matter
  - **To Build** upon existing knowledge
  - **To Construct** new knowledge, and…
- **Empowers one …**
  - **To Create their desired future**

(Senge, 2000)

WHAT do we want to assess?

- Disciplinary Knowledge (K)
- Disciplinary Skills (S)
- Disciplinary Abilities (A)
- Interdisciplinary KSAs
- Meta-cognitive skills & processes
- General Education knowledge & skills
- Critical literacies
- Transfer of KSAs across contexts
- Accreditation standards
- Intelligences
- Multi-cultural capabilities

General Education Goals

a.i. communicate in writing
a.ii. communicate by speaking and listening
a.iii. quantitative reasoning
a.iv. use of resources, including modern technology

b.i. historical development of culture
b.ii. value of the arts
b.iii. science and social science methods

c. interrelatedness of disciplines

d. (global awareness, environmental sensitivity, appreciation of cultural diversity)

Literacies

- **Traditional:**
  - Reading
  - Writing
  - Speaking
  - Quantitative

  *Meta-cognitive

- **Advancing Tech Era:**
  - Visual
  - Scientific
  - Technological

- **New – Digital Era:**
  - Information
  - Digital
  - Web-navigation

- **Should have always been:**

  * Social

  * Cultural

Intelligences

- Visual / Spatial: Show Me!
- Logical / Mathematica: Why Bother?
- Verbal / Linguistic: Who Says?
- Musical / Rhythmic: I Hear It!
- Bodily / Kinsethetic: Just Do It!
- Interpersonal / Social: Can We Talk?
- Intrapersonal /
- Introspective:
- What's in It for Me?
- Naturalistic / Physical World

Disciplinary KSAs

ABET Engineering
ABET-Engineering Technology
NAIT- Industrial Technology

Standards of Assessment Quality

- **Standard 1.**
  - ***Quality assessments arise from and accurately reflect clearly specified and appropriate achievement expectations for students***

- **Standard 2.**
  - ***Sound assessments are specifically designed to serve instructional purposes***

Standards of Assessment Quality

- **Standard 3.**
  - ***Quality assessments accurately reflect the intended target and serve the intended purpose***

- **Standard 4.**
  - ***Quality assessments provide a representative sample of student performance that is sufficient in its scope to permit confident conclusions about student achievement***

Standards of Assessment Quality

- **Standard 5.**
  - ***Sound assessments are designed, developed, and used in such a manner as to eliminate sources of bias or distortion that interfere with the accuracy of results***

Examples of Assessment Users and Uses

Classroom Level

Assessment User: Student

Sample Questions

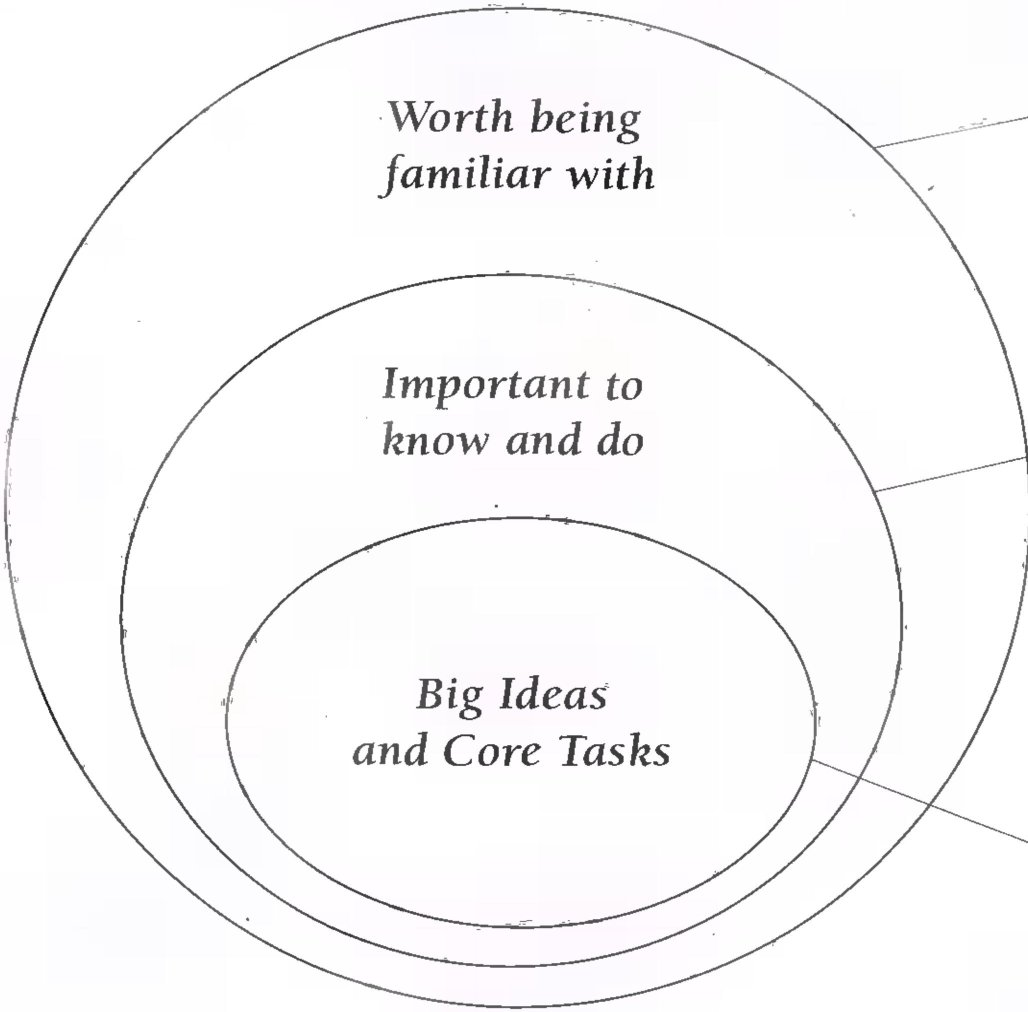
- Am I succeeding?
- Am I improving over time?
- Do I know what it means to succeed here?
- What should I do next to succeed?
- What help do I need to succeed?
- Do I feel in control of my own success?
- Does my teacher think I’m capable of success?
- Do I think I’m capable of success?
- Is the learning worth the effort?
- How am I doing in relation to my classmates?
- Where do I want all of this to take me?

Classroom Level

Assessment User: Teacher

- **Sample Questions**
  - Are my students improving?
  - Is it because of me?
  - What does this student need?
  - Is this student capable of learning this?
  - What do these students need?
  - What are their strengths that we can build on?
  - How should I group my students?
  - Am I going too fast, too slow, too far, not far enough?
  - Am I improving as a teacher
  - How can I improve?
  - Did that teaching strategy work?
  - What grade do I report?

Fig. 3.3 Clarifying Content Priorities



Familiar with

- Key figures who contributed to the development of modern statistics (Blaise Pascal and Lewis Terman)
- All nonessential terminology, for example, interquartile range (no need to be able to define these)

Important to know and do K S

- Measures of central tendency: mean, median, mode, range, standard deviation
- Data displays: bar graph, line plot, box and whiskers plot, stem and leaf plot
- Various statistical formulae and techniques

Big Ideas U

- "Average," range, degrees of confidence, lying with statistics, valid model, reliable data

Big Ideas framed as Understandings

- Statistical analysis often reveals patterns that prove useful or meaningful
- Statistics can conceal as well as reveal
- Abstract ideas, such as fairness, can be modeled statistically

Core Tasks

- Choosing the appropriate measure of central tendency in various real-world situations
- Critique of real-world statistical analyses and misleading graphs

Wiggins & McTighe (2005) p. 71

Fig. 6.2 Examples of Overarching & Topical Understandings

Overarching Understandings	Topical Understandings
• A president is not above the law.	• Watergate was a major constitutional crisis, not a "third-rate burglary" (as a Nixon staffer put it) or mere election shenanigans between political parties.
• Democracy requires a courageous, not just a free, press.	
• The modern novel overturns many traditional story elements and norms to tell a more authentic and engaging narrative.	• Holden Caulfield is an alienated antihero, not an average kid on an "excellent adventure."
• Gravity is not a physical thing but a term describing the constant rate of acceleration of all falling objects, as found through experiment.	• Vertical height, not the angle and distance of descent, determines the eventual "splashdown" speed of a falling spacecraft.
• Postulates are *logically* prior in any axiomatic system but developed *after* the fact to justify key theorems. They are neither true nor self-evident, yet they are not arbitrary.	• The parallel postulate is a crucial foundation to Euclidean geometry, despite its awkwardness and theoremlike nature.
• In a free market economy, price is a function of demand versus supply.	• A baseball card's worth depends on who wants it, not just its condition or the number of similar ones available.
	• Sales figures from eBay reveal that one person's junk is another person's treasure.
• Increased scoring opportunities in certain sports result from creating space on offense in order to spread the defense and get players "open."	• Creating space and exploiting its creation is the key to winning soccer.
	• The defense in soccer needs to prevent the offensive players from getting open in the middle of the field.

Wiggins & McTighe (2005) p. 131

Fig. 7.2 The Logic of Backward Design

Stage 1	Stage 2
If the desired result is for learners to . . .	***Then you need evidence of the student's ability to . . .***

Stage 1

Meet the standards . . . G

Standard 6—Students will understand essential concepts about nutrition and diet.

6a—Students will use an understanding of nutrition to plan appropriate diets for themselves and others.

6c—Students will understand their own eating patterns and ways in which those patterns may be improved.

Understand that . . . U

- A balanced diet contributes to physical and mental heath.
- The USDA food pyramid presents relative guidelines for nutrition.
- Dietary requirements vary for individuals based on age, activity level, weight, and overall health.
- Healthful living requires an individual to act on available information about good nutrition even if it means breaking comfortable habits.

Thoughtfully consider the questions . . . Q

- What is healthful eating?
- Are you a healthful eater? How would you know?
- How could a healthy diet for one person be unhealthy for another?
- Why are there so many health problems in the United States caused by poor eating despite all the available information?

Know and be able to . . . K S

- Use key terms—protein, fat, calorie, carbohydrate, cholesterol.
- Identify types of foods in each food group and their nutritional values.
- Be conversant with the USDA food pyramid guidelines.
- Discuss variables influencing nutritional needs.
- Identify specific health problems caused by poor nutrition.

Stage 2

- Plan a diet for different kinds of people in different kinds of settings.
- Reveal an understanding that the USDA guidelines are not absolute, but "guides"—and that there are other guides (as well as contextual variables).
- Carefully note and analyze the habits of others as well as oneself, and make supported inferences about why people eat the way they do.

That suggests the need for specific tasks or tests like . . . T

- Planning meals for diverse groups.
- Reacting to excessively rigid or loose dietary plans made by others.
- Making a good survey of what people actually eat and why.

Quizzes: On the food groups and the USDA food pyramid OE

Prompts: Describe health problems that could arise as a result of poor nutrition and explain how these could be avoided; reflections on one's own eating habits and those of others.

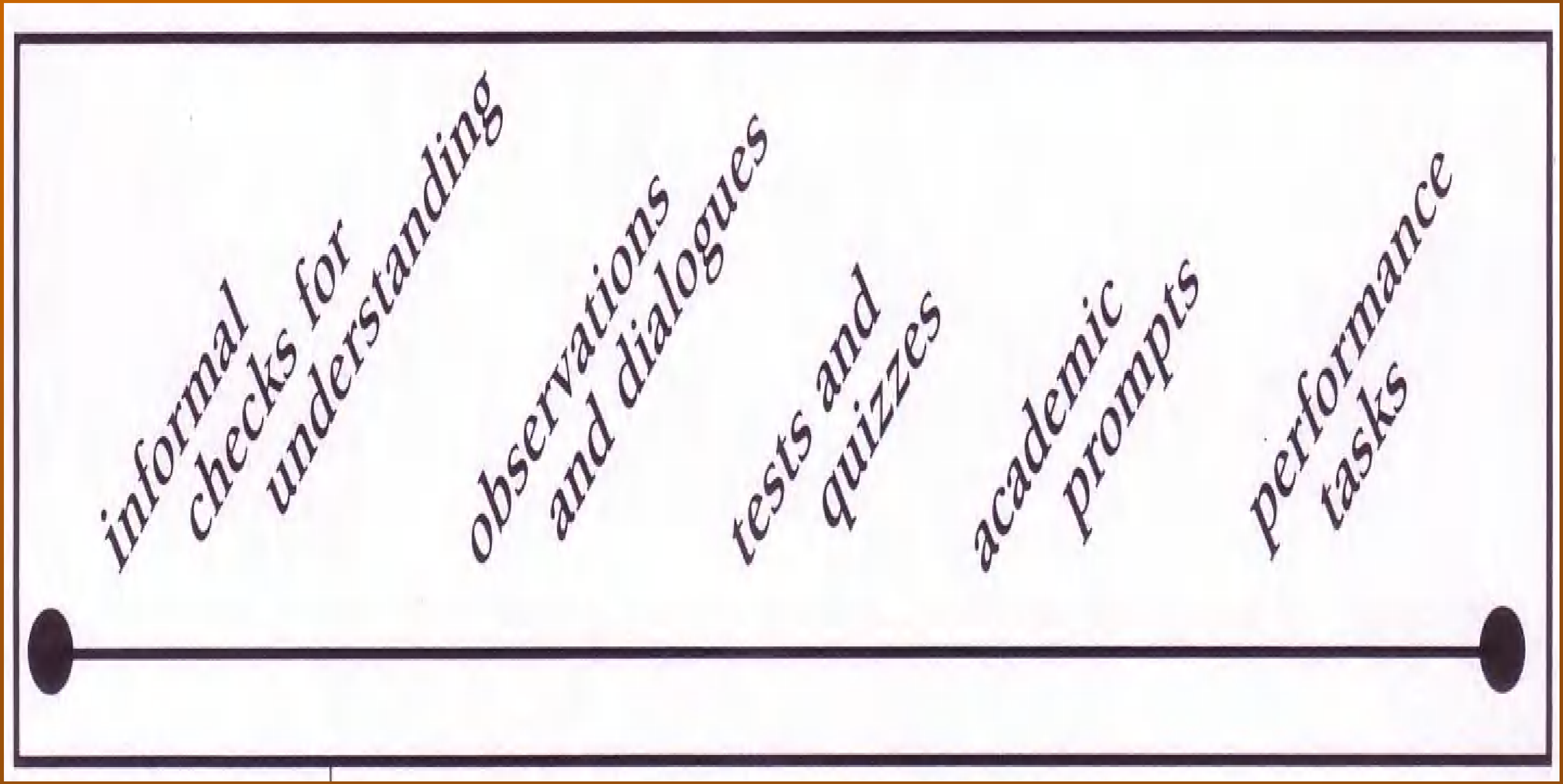
Wiggins & McTighe (2005) p. 149

Fig. 7.3 Two Approaches to Thinking About Assessment

When thinking like an assessor, we ask—	When thinking like an activity designer (only), we ask—
• What would be sufficient and revealing evidence of understanding?	• What would be fun and interesting activities on this topic?
• Given the goals, what performance tasks must anchor the unit and focus the instructional work?	• What projects might students wish to do on this topic?
• What are the different types of evidence required by Stage 1 desired results?	• What tests should I give, based on the content I taught?
• Against what criteria will we appropriately consider work and assess levels of quality?	• How will I give students a grade (and justify it to their parents)?
• Did the assessments reveal and distinguish those who really understood from those who only seemed to? Am I clear on the reasons behind learner mistakes?	• How well did the activities work? • How did students do on the test?

Wiggins & McTighe (2005) p. 151

Fig. 7.4 A Continuum of Assessments



Wiggins & McTighe (2005) p.152

Fig. 7.5 Types of Evidence

Performance Tasks T

Complex challenges that mirror the issues and problems faced by adults. Ranging in length from short-term tasks to long-term, multistaged projects, they yield one or more tangible products and performances. They differ from academic prompts in the following ways:

- Involve a real or simulated setting and the kind of constraints, background "noise," incentives, and opportunities an adult would find in a similar situation (i.e., they are authentic)
- Typically require the student to address an identified audience (real or simulated)
- Are based on a specific purpose that relates to the audience
- Allow students greater opportunity to personalize the task
- Are not secure: The task, evaluative criteria, and performance standards are known in advance and guide student work

Academic Prompts OE

Open-ended questions or problems that require the student to think critically, not just recall knowledge, and to prepare a specific academic response, product, or performance. Such questions or problems

- Require constructed responses to specific prompts under school and exam conditions
- Are "open," with no single best answer or strategy expected for solving them
- Are often "ill structured," requiring the development of a strategy
- Involve analysis, synthesis, and evaluation
- Typically require an explanation or defense of the answer given and methods used
- Require judgment-based scoring based on criteria and performance standards
- May or may not be secure
- Involve questions typically only asked of students in school

Quiz and Test Items OE

Familiar assessment formats consisting of simple, content-focused items that

- Assess for factual information, concepts, and discrete skill
- Use selected-response (e.g., multiple-choice, true-false, matching) or short-answer formats
- Are convergent, typically having a single, best answer
- May be easily scored using an answer key or machine
- Are typically secure (i.e., items are not known in advance)

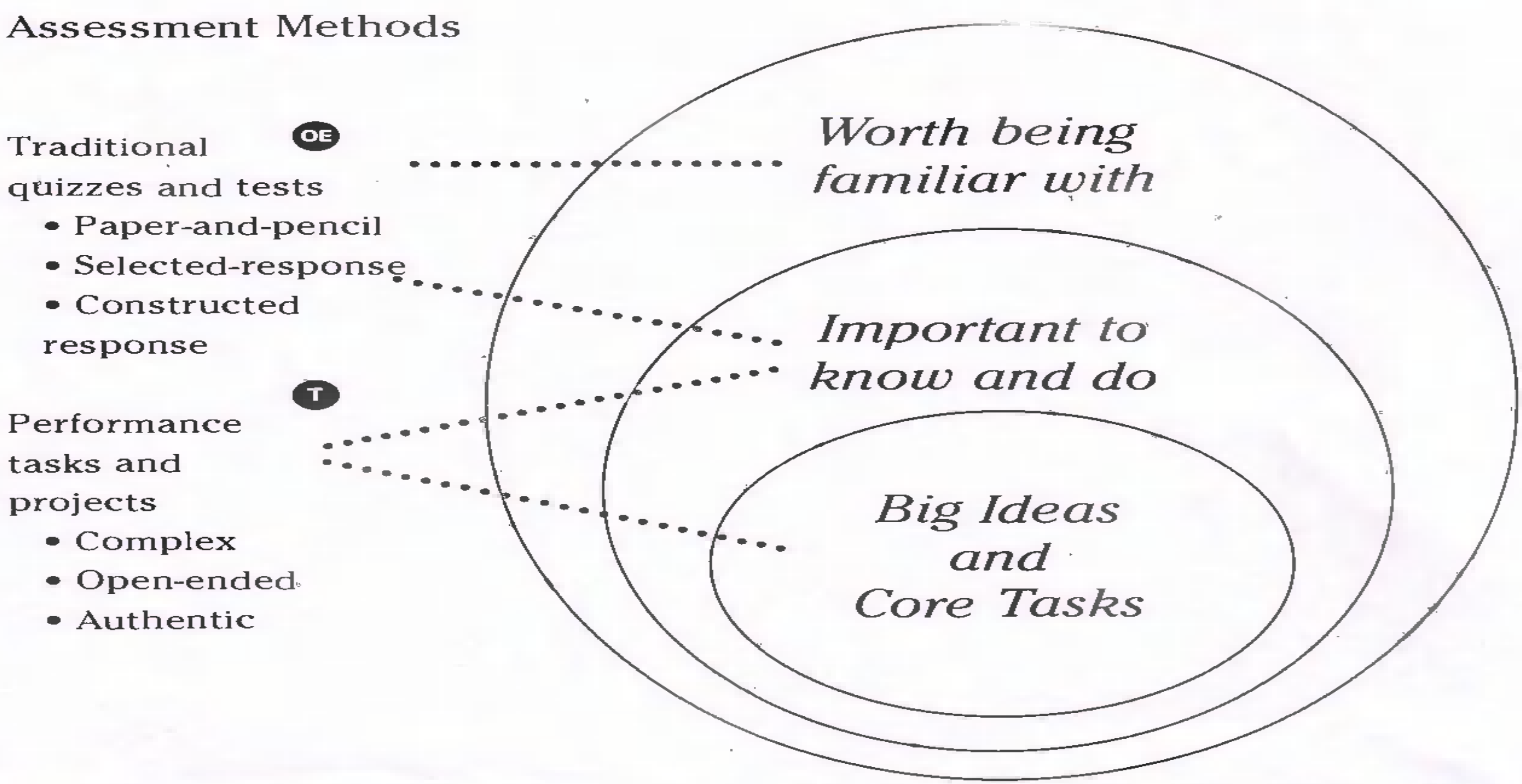
Informal Checks for Understanding OE

Ongoing assessments used as part of the instructional process. Examples include teacher questioning, observations, examining student work, and think-alouds. These assessments provide feedback to the teacher and the student. They are not typically scored or graded.

Wiggins & McTighe (2005) p.153

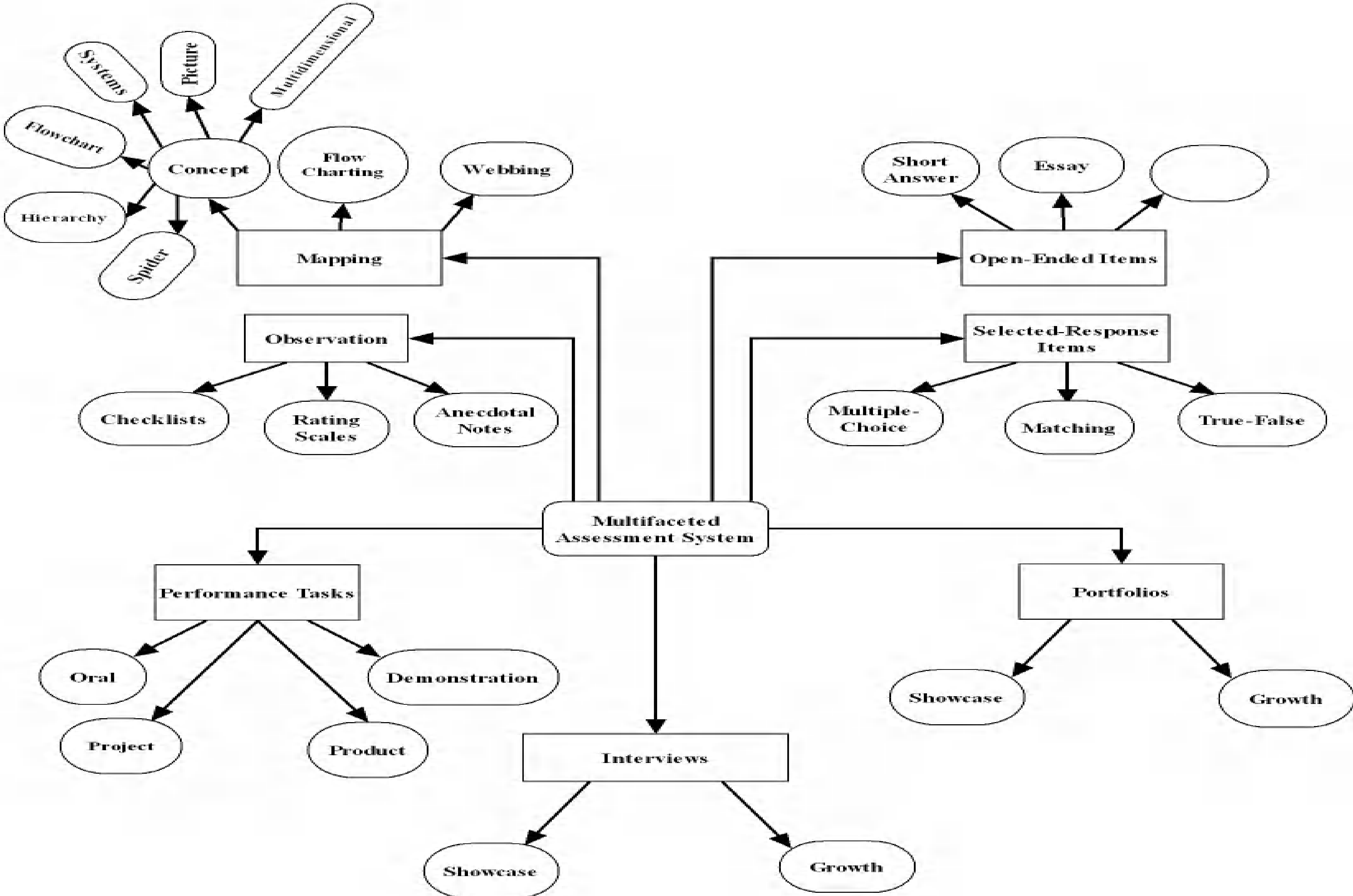
Fig. 7.11 Curricular Priorities & Assessment Methods

In effective assessments, we see a match between the type or format of the assessment and the needed evidence of achieving the desired results. If the goal is for students to learn basic facts and skills, then paper-and-pencil tests and quizzes generally provide adequate and efficient measures. However, when the goal is deep understanding, we rely on more complex performances to determine whether our goal has been reached. The graphic below reveals the general relationship between assessment types and the evidence they provide for different curriculum targets.



Wiggins & McTighe (2005) p. 170

Fig. 12.1 Multifaceted Assessment System



Kuhs et al (2001) p. 157

Figure 5.2 Typical Imbalanced Assessment in Classrooms and Schools

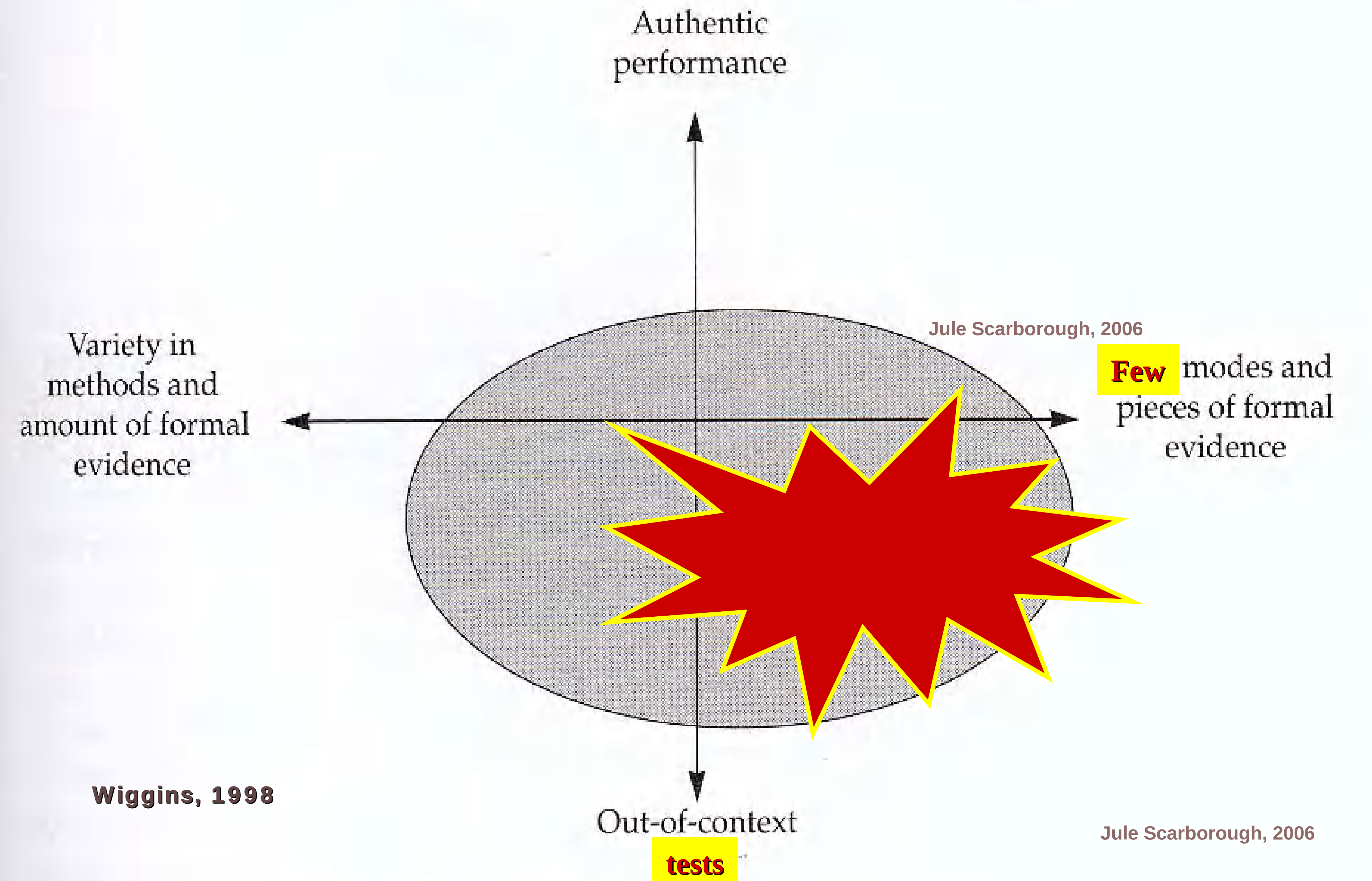
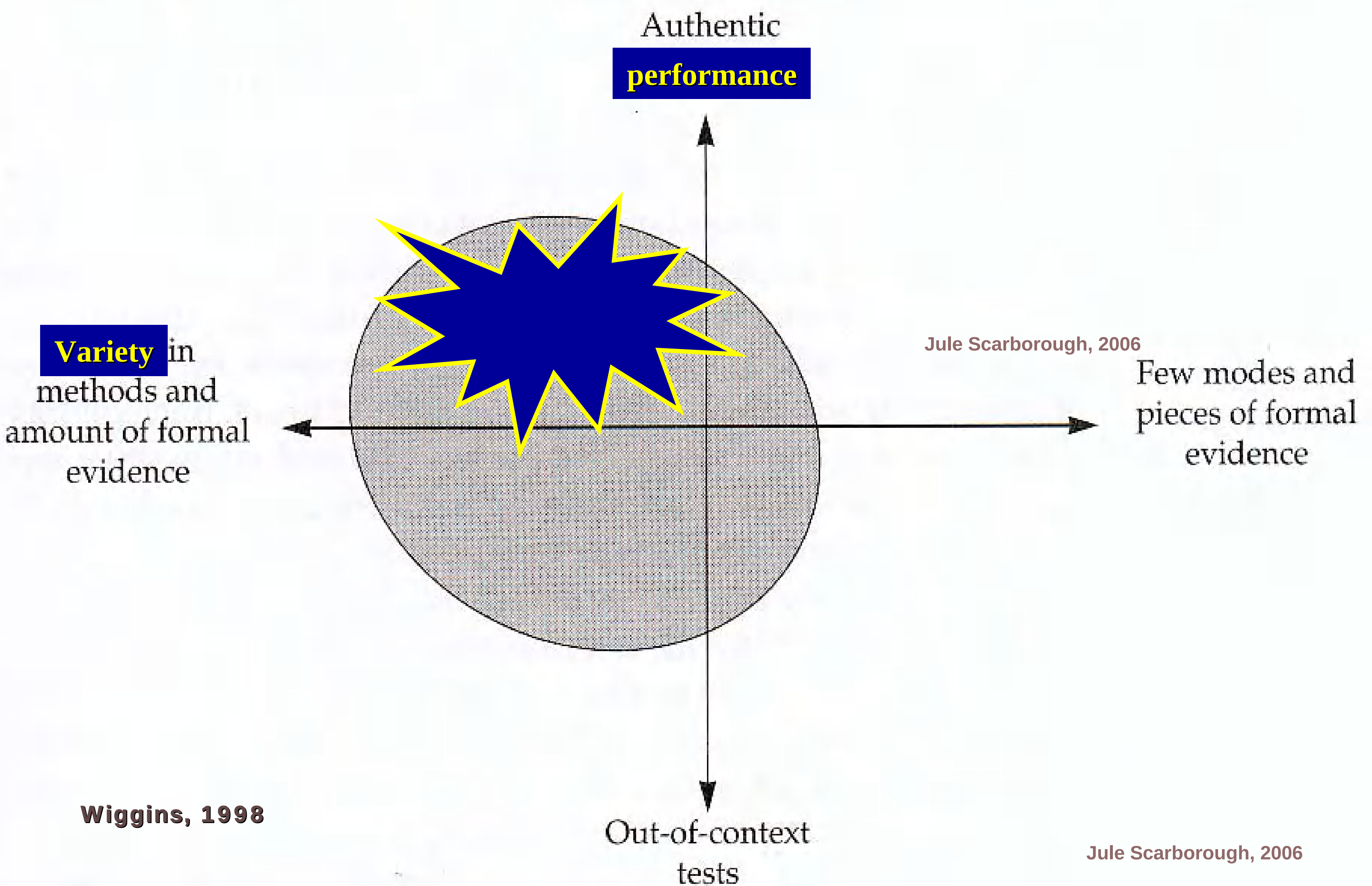


Figure 5. Exemplary Assessment Balance



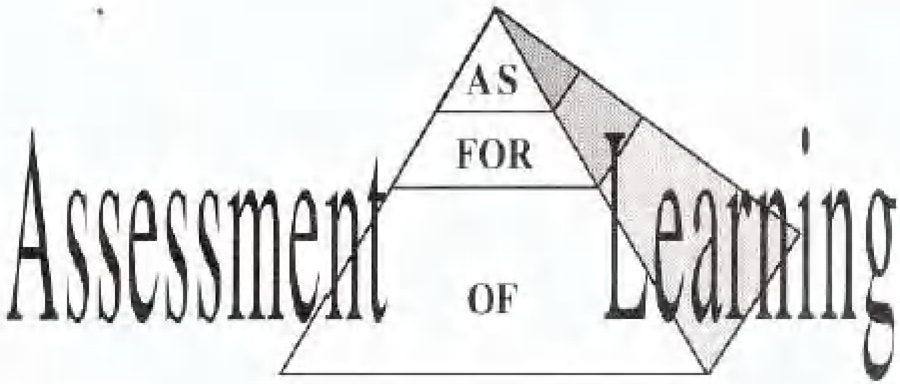


Figure 12.6 Traditional Assessment Pyramid (Marzano et al., 1993, pp. 26-27)

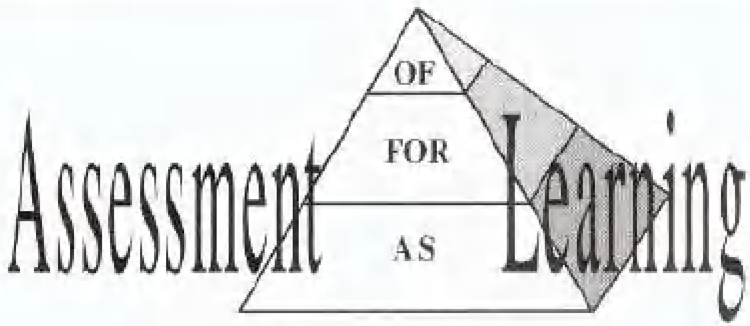


Figure 12.7 Reconfigured Assessment Pyramid (Marzano et al., 1993, pp. 26-27)

Table 12.5 Features of Assessment of, for, and as Learning

Approach	*Purpose*	*Reference Points*	*Key Assessor*
Assessment *of* Learning	Judgments about placement, promotion, credentials, etc.	Other students	Teacher
Assessment *for* Learning	Information for teachers' instructional decisions	External standards or expectations	Teacher
Assessment *as* Learning	Self-monitoring and self-correction or adjustment	Personal goals and external standards	Student

TABLE 2.2 Aligning Achievement Targets to Assessment Methods

Target to Be Assessed	*Assessment Method*			
	Selected Response	*Essay*	*Performance Assessment*	*Personal Communication*
Knowledge Mastery	Multiple choice, true/false, matching, and fill-in can sample mastery of elements of knowledge	Essay exercises can tap understanding of relationships among elements of knowledge	Not a good choice for this target—three other options preferred	Can ask questions, evaluate answers, and infer mastery—but a time-consuming option
Reasoning Proficiency	Can assess understanding of basic patterns of reasoning	Written descriptions of complex problem solutions can provide a window into reasoning proficiency	Can watch students solve some problems and infer about reasoning proficiency	Can ask student to "think aloud" or can ask follow-up questions to probe reasoning
Skills	Can assess mastery of the prerequisites of skillful performance—but cannot tap the skill itself	Can assess mastery of the prerequisites of skillful performance—but cannot tap the skill itself	Can observe and evaluate skills as they are being performed	Strong match when skill is oral communication proficiency; also can assess mastery of knowledge prerequisite to skillful performance
Ability to Create Products	Can assess mastery of knowledge prerequisite to the ability to create quality products—but cannot assess the quality of products themselves	Can assess mastery of knowledge prerequisite to the ability to create quality products—but cannot assess the quality of products themselves	A strong match can assess: (a) proficiency in carrying out steps in product development and (b) attributes of the product itself	Can probe procedural knowledge and knowledge of attributes of quality products—but not product quality

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TABLE 4.8 Advantages and Disadvantages of Assessment Methods

Assessment Method	Description	Advantages	Disadvantages
1a Written structured-response assessments	Usually timed, fixed or selected response, written exercises	■ More content can be sampled in short testing time ■ Can measure a range of cognitive skills/behaviors ■ Objective to score ■ Efficient to score ■ Can be designed to have high internal consistency ■ Efficient to administer to large groups	■ Guessing is a source of error ■ Difficult to construct technically effective items ■ Cannot be adapted to measure some behaviors (social behaviors, procedural knowledge) ■ Only one correct answer possible ■ Items typically measure discrete concepts rather than integrated knowledge and skills ■ Partial credit cannot be given
1b Written open-ended assessments	Usually timed, constructed response, written exercises	■ Can measure complex thinking and processes (organization, problem-solving, creativity, integrated skills) ■ Partial credit can be given to answers ■ Allows analytic or holistic scoring ■ More than one correct answer possible ■ Efficient to administer to large groups	■ Less content can be sampled in a given testing time ■ Bluffing causes error ■ Subjective to score without clear criteria ■ Scorer consistency needed ■ Time consuming to score ■ Cannot be used for nonwriters ■ Human scorers needed ■ Scorer training may be needed
2 Behavior-based assessments	Behaviors or demonstrations exhibited in natural or structured settings	■ Can measure complex performances and behaviors in group and individual settings ■ Requires actual demonstration and direct observation ■ More than one correct response possible ■ Allows analytic or holistic scoring ■ Partial credit [illegible] be assigned	■ Time consuming to make observations ■ Time consuming to score ■ Subjective to score without clear criteria ■ Less content can be sampled in a given time ■ Scorer consistency needed ■ Scorer training may be needed ■ Cannot be done with large groups

3 **Product-based assessments**	Products, reports, or items created in structured or unstructured situations	■ Can measure complex thinking and processes (organization, problem-solving, creativity) ■ Partial credit can be given to answers ■ Allows analytic or holistic scoring ■ More than one correct answer possible ■ Efficient to administer to large groups ■ Requires actual production ■ Requires application of product development skills ■ Can be untimed take-home exercises	■ Time consuming to score ■ Less content can be sampled in a given time ■ Limited to processes that result in products ■ Subjective to score without clear criteria ■ Scorer consistency needed ■ Human scorers needed ■ Respondents can get outside help unless structured tightly ■ Scorer training may be needed
4 **Interview-based assessments**	One-on-one verbal (oral) interaction in structured or unstructured situations	■ Needed when oral communication is the focus (language learning) ■ Preferred format for very young or special populations ■ Can measure a range of cognitive, personal-social, and effective behaviors ■ More than one correct answer possible ■ Partial credit possible ■ Allows analytical or holistic scoring	■ Time consuming to administer ■ Time consuming to score ■ Less content can be sampled in a given time ■ Limited to processes that need human interaction ■ Human interviewers needed ■ Interviewer training and structure may be needed ■ Subjective to score without clear criteria ■ Scorer consistency needed ■ Human scorers needed

TABLE 4.8 Continued

Assessment Method	Description	Advantages	Disadvantages
Portfolios	Purposeful collections of behaviors of work samples made over time	■ Can be designed to measure growth over time or periodic, summative evaluations ■ Can be easily integrated with instruction ■ Can measure complex outcomes or behaviors ■ Possible to individualize or adapt to groups ■ Can measure complex thinking and processes (organization, problem-solving, creativity) ■ Partial credit possible ■ Allows analytic or holistic scoring ■ More than one correct answer possible ■ Efficient to administer to large groups ■ Requires production of actual samples ■ Requires application of product development skills ■ Can be untimed and have take-home exercises	■ Requires proper content sampling ■ Requires adequate number of samples ■ Limited to processes or behaviors that can be included in a portfolio ■ Subjective to score without clear criteria ■ Scorer consistency needed ■ Human scorers needed ■ Respondents can get outside help ■ Scorer training may be needed

Jule Scarborough, 2006

Source: Adapted from the original by M. Baherji and Design Team, Pasco County School System (1997), published by the Bureau of Curriculum, Instruction, and Assessment, Florida Department of Education. Excerpted with permission from the Florida Department of Education [illegible]

Quizzes

- " Some teachers advocate "surprise" or **"pop"** quizzes. Their reasoning is often some vague notion that a student should always be prepared to perform on command. This seems to be an unrealistic expectation of students.

- Teachers, for example, make lesson plans and prepare to teach these lessons in advance. They are often resentful (and rightfully so) if asked to teach a class for which they have not had sufficient time to prepare. Nitko (2001,p.311)

HOW do we want to assess?

- Operational Philosophy:
  - multiple opportunities
  - diverse assessment procedures

- How
  - Traditional testing (?)
  - Problem-based
  - Performance-based

Problem-based

WHAT type of evidence of learning is desired?

- Indicators of performance
- Performances
- Transfer across contexts

Bloom's Taxonomy

(Bloom 1956)

EVAL

Make judgments about the value of ideas or materials.

SYNTHESIS

Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.

ANALYSIS

Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.

APPLICATION

Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the workplace.

COMPREHENSION

Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.

KNOWLEDGE

Recall of data.

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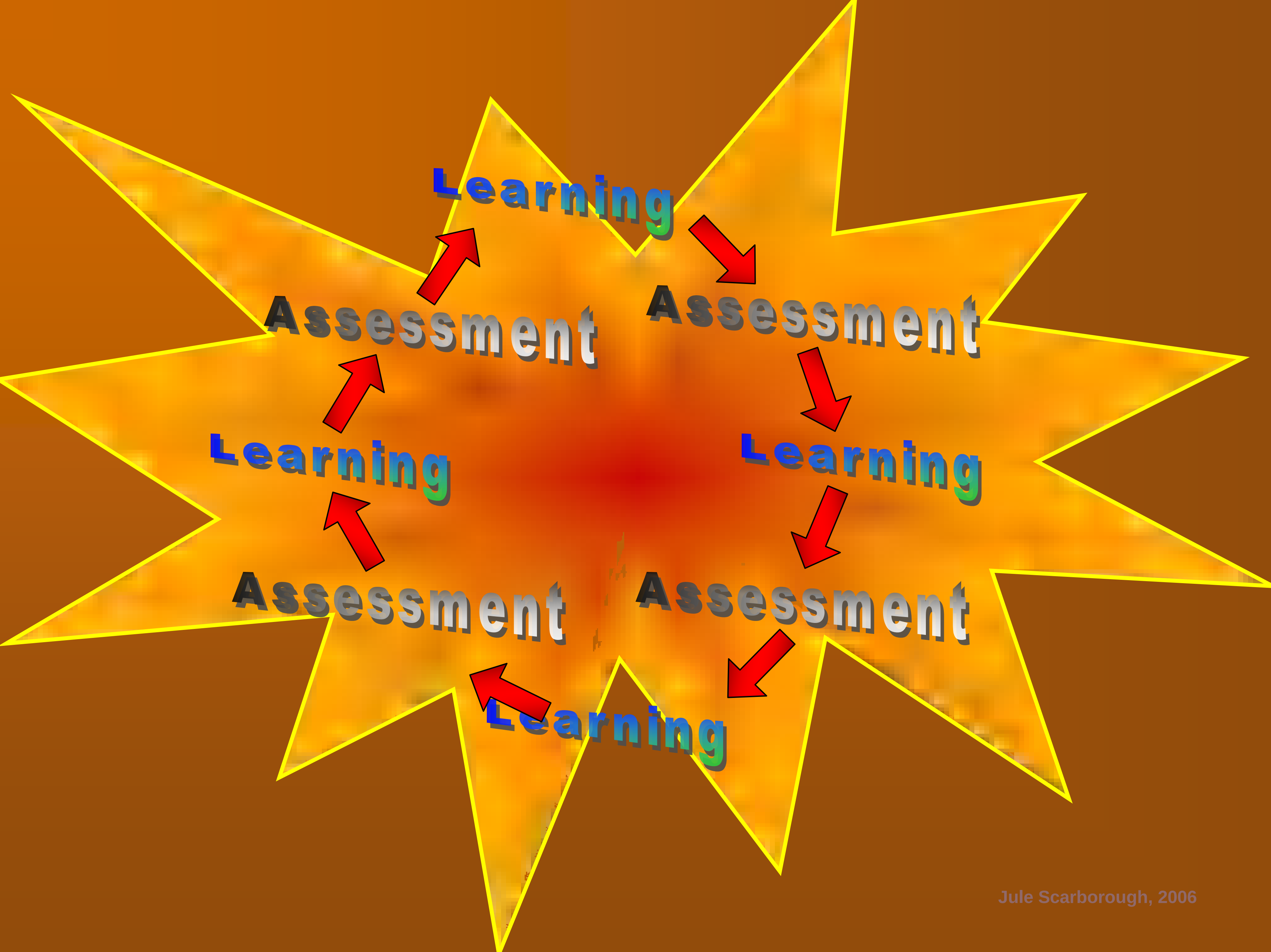
	The Cognitive Process Dimension					
The Knowledge Dimension	1. Remember	2. Understand (Comprehend)	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Meta-Cognitive Knowledge						

Valued Activities/Authenticity

- Test items - meant (only) to be useful as <u>indicators</u> of valued **"real-world"** performances


Learning
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Assessment
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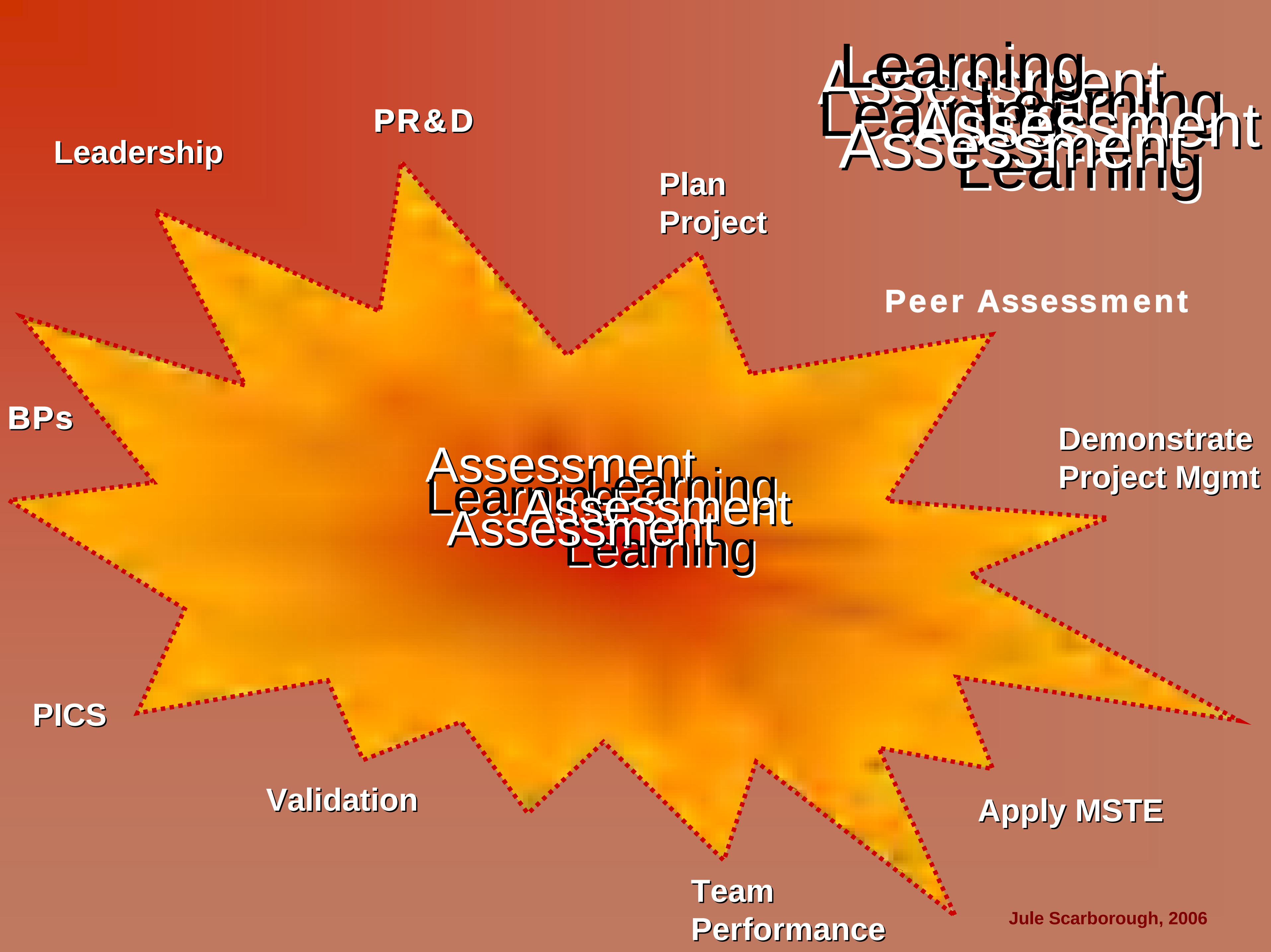
Learning
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Peer Assessment
BPs
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Assessment
Learning
Demonstrate
Project Mgmt
PICS
Validation
Apply MSTE
Team
Performance
Jule Scarborough, 2006

Performance Assessment

- Emphasizes the identification and solution of real-world problems using reasoning and higher-order thinking skills

- Based upon a community of practice

learning ***in situ***
with/from each other
situated in action
*in the **community of practice***

Characteristics of Performance Assessment

- Open-ended tasks
- Higher-order, complex skills
- Extended periods of time for performance
- Group performance
- Student and teacher choice of tasks
- Judgment scoring

(Coller, Brianno, 2006)

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Example Performance Task

Information Processing:

Select a product which is readily available in local stores and can be tested in the science lab. Collect information on the product from a wide variety of sources--magazines, newspapers, internet, and a sample of people who use the product. Keep a list of those sources and be prepared to report on which information was the most relevant and which was not very useful.

Example Performance Task

Habits of mind:

Establish a procedure for testing your product prior to beginning the project. Write down the procedure in a step-by-step order. Make sure that the elements of the scientific method are included.

Example Performance Task

Cooperation:

Assign specific duties to each member of your research team. Keep a log of team activities and progress of your testing. As you work together, you will find that you must change certain things to make your team work more effectively. Be aware of those behaviors you had to change and what you did to change them.

Example Performance Task

Communication:

Present your conclusions and findings in one of the following ways:

- **A written research report including data tables, charts, and diagrams.**
- **An article written for *Consumer Reports* magazine, complete with suggested photos, charts, tables, and diagrams.**
- **An oral presentation of your test results which incorporates visual aids. Allow listeners to ask questions and review your data gathering and analysis techniques.**

Completed Performance Task

You are a member of a team of scientists who are charged with testing the quality of a consumer product. Your team must design an experiment to test the product, collect appropriate data, draw conclusions, and compile a report regarding the quality of the product.

Select a product which is readily available in local stores and can be tested in the science lab. Collect information on the product from a wide variety of sources--magazines, newspapers, internet, and a sample of people who use the product. Keep a list of those sources and be prepared to report on which information was the most relevant and which was not very useful.

Establish a procedure for testing your product prior to beginning the project. Write down the procedure in a step-by-step order. Make sure that the elements of the scientific method are included.

Assign specific duties to each member of your research team. Keep a log of team activities and progress of your testing. As you work together, you will find that you must change certain things to make your team work more effectively. Be aware of those behaviors you had to change and what you did to change them.

Present your conclusions and findings in one of the following ways:

- A written research report including data tables, charts, and diagrams.
- An article written for *Consumer Reports* magazine, complete with suggested photos, charts, tables, and diagrams.
- An oral presentation of your test results which incorporates visual aids. Allow listeners to ask questions and review your data gathering and analysis techniques.

Check For:

- **Complex thinking – Critical thinking**

  (scenario requires complex thinking skills)

- **Information processing**

  (scenario requires gathering, processing, & evaluating information)

- **Habits of mind**

  (scenario requires self regulation & critical thinking)

- **Collaboration/Cooperation – Teamwork**

- **Tangible product/performance – Real World**

Figure 2.1 Key Differences Between Typical Tests and Authentic Tasks

Typical Tests	*Authentic Tasks*	*Indicators of Authenticity*
Require correct responses only	Require quality product and/or performance, and *justification*.	We assess whether the student can explain, apply, self-adjust, or justify answers, not just the correctness of answers using facts and algorithms.
Must be unknown in advance to ensure validity	Are known as much as possible in advance; involve excelling at predictable demanding and core tasks; are not "gotcha!" experiences.	The tasks, criteria, and standards by which work will be judged are predictable or known—like the recital piece, the play, engine to be fixed, proposal to a client, etc.

Figure 2.1 Key Differences Between Typical Tests and Authentic Tasks

Typical Tests	*Authentic Tasks*	*Indicators of Authenticity*
Are disconnected from a realistic context and realistic constraints	Require real-world use of knowledge: the student must "do" history, science, etc. in realistic simulations or actual use.	The task is a challenge and a set of constraints that are authentic—likely to be encountered by the professional, citizen or consumer. (Know-how, not plugging in, is required.)
Contain isolated items requiring use or recognition of known answers or skills	Are integrated challenges in which knowledge and judgment must be innovatively used to fashion a quality product or performance.	The task is multifaceted and non-routine, even if there is a "right" answer. It thus requires problem clarification, trial and error, adjustments, adapting to the case or facts at hand, etc.
Are simplified so as to be easy to score reliably	Involve complex and non-arbitrary tasks, criteria, and standards.	The task involves the important aspects of performance and/or core challenges of the field of study, not the easily scored; does not sacrifice validity for reliability.

Figure 2.1 Key Differences Between Typical Tests and Authentic Tasks

Typical Tests	*Authentic Tasks*	*Indicators of Authenticity*
Are one shot	Are iterative: contain recurring essential tasks, genres, and standards.	The work is designed to reveal whether the student has achieved real versus pseudo mastery, or understanding versus mere familiarity, over time.
Depend on highly technical correlations	Provide direct evidence, involving tasks that have been validated against core adult roles and discipline-based challenges.	The task is valid and fair on its face. It thus evokes student interest and persistence, and seems apt and challenging to students and teachers.
Provide a score	Provide usable, diagnostic (sometimes concurrent) feedback: the student is able to confirm results and self-adjust as needed.	The assessment is designed not merely to audit performance but to improve future performance. The student is seen as the primary "customer" of information.

Authentic Assessment involves:

- Tasks which look and feel like learning activities rather than tests

- Tasks which are worthwhile, significant, and meaningful (relevant) to students

- Tasks which involve higher-order thinking skills

Authentic Assessment is designed to:

- stress important understandings and abilities
- be educational and engaging
- be a part of the curriculum
- reflect real-life, interdisciplinary challenges
- present students with complex, open-ended problems and tasks that integrate knowledge and skills

Authentic Assessment is structured:

- with tasks which warrant practicing and repeating
- so that collaboration with other students is often necessary
- such that students know in advance how they will be assessed
- so that varying amounts of time are available
- to allow for a significant degree of student choice

Definition
Authentic Performance Assessment

- A description of a "real life" project or task in which students simultaneously learn and are assessed according to established benchmarks.

Authentic Performance Tasks

- Involve engaging problems and questions of importance and substance
- Simulate challenges facing persons in the "real world"
- Require a repertoire of knowledge and skills
- Focus on a student's ability to produce a product or performance
- Involve "de-mystified" criteria and standards

Authentic Performance Tasks

- Rely on trained assessor judgment
- Often involve interactions between assessor and student
- Often requires the student to justify answers and respond to follow-up questions
- Provides challenges where the product determines the quality of the result
- Involves patterns of response and behavior

Constructing Performance Tasks

Constructing Performance Tasks

- **Step 1:** Identify a content standard to be included. Standards from an integrated module might include:

Insert ABET/TAC/NAIT –standard & SLO(s) here: (Can be a “cluster”)

- 5A: Locate, organize, and use information from various sources to answer questions, solve problems and communicate ideas.
- 8B: Interpret and describe numerical relationships using tables, graphs and symbols.
- 11A: Know and apply the concepts, principles and processes of scientific inquiry.

Constructing Performance Tasks

- **Step 2:** Structure the task around a real world scenario from Community of Practice – real and relevant.

“Real-World” Scenario

- A paragraph which describes a scenario in the world outside of the classroom in communities of practice where individuals’ jobs require them to demonstrate skills and knowledge which are addressed in the selected goal, standards, and benchmarks.

Example “Real-World” Scenario

You are a member of a team of scientists who are charged with testing the quality of a consumer product. Your team must design an experiment to test the product, collect appropriate data, draw conclusions, and compile a report regarding the quality of the product

Scoring Performance Tasks

Assessment Problems Associated with Performance Tasks

- There is no single correct response
- Tasks are often done by groups of students
- They require qualitative judgements by teachers
- Grading is often time consuming
- Qualitative judgements may be inconsistent

Solution: Rubrics

Rubrics Contain:

- **Established set of criteria** used in scoring or rating student performance
- The criteria take the form of performance descriptors associated with predetermined levels of achievement
- Rubrics may be supplemented with a ***benchmark*** for each descriptor which indicates a sample of student work which meets the criteria.

Table 12.6 Rubric for Assessing the Quality of a Performance Task

Key Components

A properly designed Performance Task must:

a. be based on content standards taken from the *Illinois Learning Standards*
b. describe a "real-life" scenario
c. involve students in complex reasoning processes
d. require students to collect and process information
e. incorporate "habits of mind"
f. require student collaboration and cooperation
g. result in a tangible product or communication activity

I. Component: The Performance Task is based on the *Illinois Learning Standards.*
1. The Performance Task is directly related to and based on Learning Standards.
2. Learning Standards are apparent, but the relation to the task is sketchy or irrelevant.
3. The Performance Task does not appear to be based on Learning Standards.

II. Component: A "Real-Life" scenario is described in the Performance Task.
1. The scenario described in the task accurately mirrors an activity in the community outside the classroom.
2. The scenario described in the task simulates an activity in the community outside the classroom.
3. The scenario described in the task contains some aspects of activity outside the classroom but is largely contrived.
4. The scenario described in the task is an academic exercise that usually takes place only in the context of a school setting.

III. Component: The Performance Task involves students in complex reasoning processes.
1. The task requires students to utilize complex reasoning components, such as induction/deduction, diagnosis, abstracting, experimental inquiry, or problem solving.
2. The task requires students to utilize complex reasoning components, such as comparing, classifying, decision making, or investigation.
3. The task requires students to only recall facts.

IV. Component: The Performance Task requires students to collect and process information.
1. The task incorporates a variety of information gathering techniques and information resources. Students are required to interpret and synthesize information and accurately assess the value of information gathered.
2. The task requires students to gather and synthesize information, but the value of the information gathered is not assessed.
3. The task requires students to gather information but not to interpret it.
4. The task requires no gathering or processing of information.

Virtues of Rubrics

- They communicate key components of student performance
- They promote easier assessment
- They increase reliability and consistency
- They show students where they are and how they can improve
- They aid in documenting progress

Example Rubric

Key Component:

Drawing conclusions based on experimental data

Level

- **3** Draws a conclusion that is supported by the data and gives supporting evidence for the conclusion
- **2** Draws a conclusion that is supported by data, but fails to show any evidence for the conclusion
- **1** Draws a conclusion that is not supported by data
- **0** Fails to reach a conclusion

Example Performance Task

You are a member of a team of scientists who are charged with testing the quality of a consumer product. Your team must design an experiment to test the product, collect appropriate data, draw conclusions, and compile a report regarding the quality of the product.

Select a product which is readily available in local stores and can be tested in the science lab. Collect information on the product from a wide variety of sources--magazines, newspapers, internet, and a sample of people who use the product. Keep a list of those sources and be prepared to report on which information was the most relevant and which was not very useful.

Establish a procedure for testing your product prior to beginning the project. Write down the procedure in a step-by-step order. Make sure that the elements of the scientific method are included.

Assign specific duties to each member of your research team. Keep a log of team activities and progress of your testing. As you work together, you will find that you must change certain things to make your team work more effectively. Be aware of those behaviors you had to change and what you did to change them.

Present your conclusions and findings in one of the following ways:

- A written research report including data tables, charts, and diagrams.
- An article written for *Consumer Reports* magazine, complete with suggested photos, charts, tables, and diagrams.
- An oral presentation of your test results which incorporates visual aids. Allow listeners to ask questions and review your data gathering and analysis techniques.

Identify Key Components

- Product Testing
  - Design a test procedure
  - Follow the procedure
- Data Collection
- Drawing Conclusions
- Reporting Results

Rubrics

- **Reveals the scoring "rules"**

  -explains the criteria against which student work will be judged

- **More importantly!**

  -makes public key criteria that students can use in developing, judging, and revising work

Figure 7.2 Rubric for Open-Ended Mathematical Problems

	Demonstrated Competence
Exemplary Response: Rating = 6	Gives a complete response with a clear, coherent, unambiguous, and elegant explanation; includes a clear and simplified diagram; communicates effectively to the identified audience; shows understanding of the problem's mathematical ideas and processes; identifies all the important elements of the problem; may include examples and counterexamples; presents strong supporting arguments.
Competent Response: Rating = 5	Gives a fairly complete response with reasonably clear explanations; may include an appropriate diagram; communicates effectively to the identified audience; shows understanding of the problem's ideas and processes; identifies most important elements of the problem; presents solid supporting arguments.
	Satisfactory Response
Minor Flaws But Satisfactory: Rating = 4	Completes the problem satisfactorily, but the explanation may be muddled; argumentation may be incomplete; diagram may be inappropriate or unclear; understands the underlying mathematical ideas; uses ideas effectively.
Serious Flaws But Nearly Satisfactory: Rating = 3	Begins the problem appropriately but may fail to complete or may omit significant parts of the problem; may fail to show full understanding of mathematical ideas and processes; may make major computational errors; may misuse or fail to use mathematical terms; response may reflect an inappropriate strategy for solving the problem.
	Inadequate Response
Begins, But Fails to Complete Problem: Rating = 2	Explanation is not understandable; diagram may be unclear; shows no understanding of the problem situation; may make major computational errors.
Unable to Begin Effectively: Rating = 1	Words used do not reflect the problem; drawings misrepresent the problem situation; fails to indicate which information is appropriate.
No Attempt Rating = 0	

Jule Scarborough, 2006

Appendix

Figure 7.6 Rubrics for a Socratic Seminar

	Conduct	*Leadership*	*Reasoning*	*Listening*	*Reading*
Excellent	Demonstrates respect, enthusiasm, and skill for the purpose of seminar: insight into important texts and ideas gained through the interplay of collaborative and personal inquiry into a text. Demonstrates in speech and manner a habitual respect for the text, reasoned discussion, and shared inquiry. Effectively contributes to deepening and broadening the conversation, revealing exemplary habits of mind	Takes clear responsibility for the seminar's progress or lack of it. Takes stock of the overall direction and effectiveness of the discussion, and takes apt steps to refocus or redirect conversation and/or to cause others to rethink previous statements. Offers apt feedback and effective guidance to others. Takes steps to involve reticent participants and to ensure that unnoticed points are attended to.	Arguments are reasonable, apt, logical and substantiated with evidence from the text so as to consistently move the conversation forward and deepen the inquiry. The analyses made are helpful in clarifying complex ideas. Criticisms made are never ad hominem.	Listens unusually well. Takes steps routinely to comprehend what is said, is consistently attentive (as reflected in direct and indirect evidence). Later responses (actions, comments, and writings) indicate accurate and perceptive recall of what was said and by whom.	Conduct and written work indicate student has read the text carefully, is thoroughly familiar with the text's main ideas, can offer insightful interpretations and evaluations of it, is respectful of the text while also reading it critically, and has come prepared with thoughtful questions and reactions.
Good	Demonstrates in speech and manner an overall respect for and understanding of the goals, processes, and norms of reasoned discussion and shared inquiry. Participates to advance conversation and displays mature habits of mind, but may sometimes be ineffective in sharing insights, advancing inquiry, or working with others.	Is generally willing to take on facilitative roles and responsibilities. Either makes regular efforts to be helpful (in moving the conversation forward and/or including others in it) but is sometimes ineffective in doing so; or does not typically take a leadership role but is effective when does so.	Arguments are generally reasonable, apt, and logical. There may be some minor flaws in reasoning, evidence, or aptness of remarks, but the ideas contribute to an understanding of the text or of comments made by others. Criticisms are rarely ad hominem	Listens well. Takes steps to comprehend what is said Generally pays attention and/or responds appropriately to ideas and questions offered by other participants. Later responses involve accurate recall of what was said and by whom.	Conduct and written work generally indicate student has read the text carefully, grasps the main ideas, can offer reasonable (if sometimes incomplete or surface) interpretations, and has come with apt questions and ideas regarding the text.

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Figure 7.6 Continued

	Conduct	Leadership	Reasoning	Listening	Reading
Fair.	Speech and manner suggest that the student misunderstands the purpose of the discussion and/or is undisciplined concerning seminar practices and habits of mind. May contribute, even frequently, to conversation but is ineffective due to opinionated, unclear, and/or inadequately explicit views.	Takes on facilitative roles and responsibilities infrequently and/or ineffectively. When taking on a leadership role, may misconstrue the responsibility by lobbying for favored opinions or speakers only, and/or by trying to close off discussion of diverse and unresolved views in favor of neat-and-clean premature closure.	Unsubstantiated or undeveloped opinions are offered more than sound arguments. Comments suggest that the student has some difficulty in moving beyond mere reactions to more thorough arguments, or difficulty in following the complex arguments of others (as reflected in questions asked and/or non sequiturs). Student may sometimes resort to ad hominem attacks instead of focusing on the critique of claims and arguments.	Does not regularly listen very well and/or is not always attentive, as reflected in comments and body language. Verbal reactions reflect an earlier difficulty or failure to listen carefully to what was said. Behavior may signify either that the student lacks effective note-taking strategies and/or does not grasp the importance of listening to different points of view and reflecting on them.	Comments indicate that the student may have read the text but has either misunderstood it (due either to difficulties in reading and/or assuming a stance that is too egocentric or present-centered) or has not put enough disciplined and focused effort into preparing for the seminar. Varying patterns of participation also suggest that the student's preparation is inconsistent.
Unsatisfactory	Speech and manner display little respect for and/or understanding of the seminar process. Student appears to lack essential habits of mind: is either routinely argumentative, distracting, and/or obstinate, or is disengaged—extremely reluctant to participate, even when called upon (to the point of making others feel the detachment).	Plays no active facilitation role of any kind, or actions are consistently counterproductive in that role.	Comments suggest that student has great difficulty with analytical requirements of seminar. Remarks routinely appear to be non sequiturs and/or so illogical or without substantiation as to be not followable by others. Student may often resort to ad hominem comments to text author and other students.	Does not listen adequately, as reflected in later questions or comments (for example, non sequiturs and repetition of earlier points as if they hadn't been spoken) and/or body language that is very suggestive of inattentiveness.	Student either is generally unable to make adequate meaning of texts or has generally come to class unprepared. The student may be unable to read complex texts and/or may not know or use disciplined strategies for understanding and taking notes on such texts.

FIGURE 6-1 Rubric for Formal Oral Communication in a Graduate Program

Criteria	Levels of Achievement: 3 Sophisticated	2 Competent	1 Not Yet Competent
Organization			
	Presentation is clear, logical, and organized. Listener can follow line of reasoning.	Presentation is generally clear and well organized. A few minor points may be confusing	Listener can follow presentation only with effort. Some arguments are not clear. Organization seems haphazard.
Style			
	Level of presentation is appropriate for the audience. Presentation is a planned conversation, paced for audience understanding. It is not a reading of a paper. Speaker is clearly comfortable in front of the group and can be heard by all.	Level of presentation is generally appropriate. Pacing is sometimes too fast or slow. The presenter seems slightly uncomfortable at times, and the audience occasionally has trouble hearing him/her	Aspects of presentation are too elementary or too sophisticated for audience. Presenter seems uncomfortable and can be heard only if listener is very attentive. Much of the information is read.
Use of Communication Aids (e.g., Transparencies, Slides, Posters, Handouts, Computer-Generated Materials)			
	Communication aids enhance the presentation. They are prepared in a professional manner. Font on visuals is large enough to be seen by all	Communication aids contribute to the quality of the presentation. Font size is appropriate for reading. Appropriate information is included. Some material is n...	Communication aids are poorly prepared or used inappropriately. Font is too small to be easily seen. Too much information is included. Unimportant material

Content			
Depth of Content	Speaker provides an accurate and complete explanation of key concepts and theories, drawing upon relevant literature. Applications of theory are included to illuminate issues. Listeners gain insights.	For the most part, explanations of concepts and theories are accurate and complete. Some helpful applications are included.	Explanations of concepts and/or theories are inaccurate or incomplete. Little attempt is made to tie theory to practice. Listeners gain little from the presentation.
Accuracy of Content	Information (names, facts, etc.) included in the presentation is consistently accurate.	No significant errors are made. Listeners recognize any errors to be the result of nervousness or oversight.	Enough errors are made to distract a knowledgeable listener, but some information is accurate. The presentation is useful if the listener can determine what information is reliable.
Use of Language			
Grammar and Word Choice	Sentences are complete and grammatical, and they flow together easily. Words are chosen for their precise meaning.	For the most part, sentences are complete and grammatical, and they flow together easily. With a few exceptions, words are chosen for their precise meaning.	Listeners can follow the presentation, but they are distracted by some grammatical errors and use of slang. Some sentences are incomplete/halting, and/or vocabulary is somewhat limited or inappropriate.

FIGURE 6–1 *Continued*

Criteria	Levels of Achievement: 3 Sophisticated	2 Competent	1 Not Yet Competent
Freedom from Bias (e.g., Sexism, Racism, Agism, Heterosexism, etc.)	Both oral language and body language are free from bias.	Oral language and body language are free from bias with one or two minor exceptions.	Oral language and/or body language includes some identifiable bias. Some listeners will be offended.
Personal Appearance			
	Personal appearance is completely appropriate for the occasion and the audience.	Personal appearance is generally appropriate for the occasion and audience. However, some aspects of appearance reflect a lack of sensitivity to nuances of the occasion or expectations of the audience.	Personal appearance is inappropriate for the occasion and audience.
Responsiveness to Audience			
Verbal Interaction	Consistently clarifies, restates, and responds to questions. Summarizes when needed.	Generally responsive to audience comments, questions, and needs. Misses some opportunities for interaction.	Responds to questions inadequately.
Body Language	Body language reflects comfort interacting with audience.	Body language reflects some discomfort interacting with audience.	Body language reveals a reluctance to interact with audience.

(Adapted from Department of Educational Leadership and Policy Studies, 1998)

FIGURE 6-2 Rubric for Engine Design Project

Criteria	Excellent (A) 4 points	Good (B) 3 points	Needs Improvement (C, D) 2 points	Unacceptable (F) 1 point
	Levels of Achievement			
Formulation of Design Problem				
Formulation and scope of problem	Design problem formulation is clear and well thought out. The problem scope is well defined.	The problem formulation is clear, but the scope is not well defined.	The problem formulation is unclear in some respects and does not appear to be well thought out.	The design problem is not formulated clearly.
Significance	The problem chosen represents a current challenge facing the engine industry. The potential market is large and clearly identified.	The problem represents a current challenge in the engine industry, but the potential market is small or is not clearly identified.	The problem does not represent a current challenge in the engine industry, and the market is small or is not clearly identified.	The problem does not represent a current challenge in the engine industry. There is no explanation about who would be interested in the product or why they should buy it. There is no evidence of the background work (e.g., market analysis) that is needed to design an engine.

Continued

FIGURE 6–2 *Continued*

Criteria	Excellent (A) 4 points	Good (B) 3 points	Needs Improvement (C, D) 2 points	Unacceptable (F) 1 point
		Levels of Achievement		
ngineering Skill Utilization				
Analysis	Engineering analysis is detailed and challenging and is used at every stage of the design process.	The engineering analysis is detailed and challenging, but some steps do not appear to be supported by calculations	Some analysis is included, but it is not very detailed or challenging Many steps are not supported by calculations.	Engineering analysis is infrequently used. When used, it appears trivial and leads to obvious conclusions.
Documentation	Documentation is thorough and complete.	There is some missing information in the documentation.	There is a great deal of missing information in the documentation	Documentation is poor or nonexistent.
Assumptions	All assumptions are stated and justified.	Assumptions are stated, but some are not justified.	Assumptions are stated, but none are justified.	No assumptions are stated.
Extension of Knowledge about Internal Combustion Engines				
	Concepts beyond those in the prerequisite course are frequently used. The professor may have learned something new.	Prerequisite course content is used easily, and some material beyond the course is included.	Prerequisite course content is used, but new and unfamiliar areas are not introduced.	Prerequisite course content is not applied correctly New areas are not included.

Team Skills

Group functioning	The group functions well. Peer review indicates good distribution of effort. All members are challenged and feel their contributions are valued.	The group functions fairly well. Some people in the group believe they are working harder (or less hard) than others, but everyone is contributing.	The group is still functioning, but each individual is doing his/her own work and ignoring the efforts of others. There are frequent episodes where one person's design will not fit with another's due to lack of communication.	The group functions poorly. All work is the product of individual efforts.
Regularity and productivity of meetings	The group meets regularly and the meetings are productive.	The group meets regularly, but meetings are not as productive as they could be. Some members are not prepared.	The group meets irregularly. Meetings are not as productive as they could be because several members are not prepared	The group does not meet regularly, and when it does, some members are absent and no one is prepared
Use of group problem-solving techniques	The group makes frequent use of brainstorming and group problem-solving techniques and documents the effect of these sessions.	The group uses brainstorming and group problem-solving techniques but does not always document the effect of these sessions.	Some attempt to use group problem-solving techniques is observed, but decisions are not based on results of problem-solving sessions.	No attempt to use group problem-solving techniques is made. Meetings are worthless.

Written Communication

Organization	Written work is well organized and easy to understand.	The organization is generally good, but some parts seem out of place.	The organization is unclear.	The report is disorganized to the extent that it prevents understanding of content.
Definition of terms	All new terms are defined.	Some terms are used without definition.	Many terms are used but not defined.	Terms are used without definition to the extent that understanding is inhibited.

Continued

FIGURE 6–2 *Continued*

Criteria	Levels of Achievement Excellent (A) 4 points	Good (B) 3 points	Needs Improvement (C, D) 2 points	Unacceptable (F) 1 point
Integration of writing styles	The team developed a writing style that is uniform throughout the report. There is no indication that the report involved multiple authors.	There is some indication of multiple authors (e.g., different fonts, different paper, etc.).	There is ample indication of multiple authors (e.g., different fonts, different paper, etc.).	Report is clearly the work of multiple authors with different writing styles, margins, printer fonts, and paper types.
Grammar	The work has been thoroughly spell-checked and proofread by everyone in the group.	There are a few spelling and grammatical errors.	There is more than one spelling or grammatical error per page	There are frequent misspelled words and serious grammatical errors, indicating that time was not taken to spell-check and proofread.
Use of appendices	Information is appropriately placed in either the main text or an appendix. Appendices are documented and referenced in the text.	Information is appropriately placed in either the main text or an appendix. Documentation and referencing in text are somewhat incomplete.	There is some misplacement of information in the text vs. the appendix. Appendices are poorly documented and referenced in text.	Considerable amount of material is misplaced. Appendices are not documented or referenced in text.

Oral Communication

Interest/ organization	Design presentation is clear, interesting, and well organized. It starts and ends well.	The design presentation is interesting, but some points are unclear. The introduction and/or conclusion are weak.	The design presentation has some interesting points but is difficult to follow. Either the introduction or conclusion is missing.	The design presentation is hard to follow and poorly organized. It appears to be off-the-cuf There is no introduction or conclusion.
Visual aids	Visual aids are used frequently. They are easy to read and understand, and they are of professional quality.	Visual aids are good, but a few are sloppy or difficult to read.	Most visual aids are sloppy and hard to read.	There are too few visual aids, and those used are carelessly prepared.
Length	The presentation is within the assigned time limits.	The presentation is too short or too long by two minutes or more.	The presentation is too short or too long by five minutes or more.	The presentation is too short or too long by ten minutes or more.
Engineering analysis	Engineering analysis is presented with sufficient detail to be understood, but not so that it insults the audience.	Engineering analysis is poorly explained or so detailed that the audience falls sleep.	Engineering analysis consists of trivial calculations and is poorly explained.	No engineering analysis is presented.

(Van Gerpen, 1999)

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ITEM and TEST ANALYSIS

CEET Faculty Development Program

The Scholarship of Teaching

Student Assessment Program Component

CEET Initiative on Teaching and Learning
Test Item Analysis – Feb. 16, 2006

A. Some Textbook Discussion of Item Analysis

B. Purposes of Item Analysis

C. Factors Affecting Item Statistics

D. Item Analysis Example
  - Definition of Item Difficulty
  - Definition of Item Discrimination
  - Item Discrimination – A Closer Look

E. Complete Item Analysis of AHP Test
  - Discussion of Flagged Items

F. Analyze Items in Your Exams

G. Validity, Reliability, and Standard Error of Measurement

H. Using Testing Services' Scanning and Analysis Services

Definitions of Item Difficulty and Item Discrimination

Item Difficulty

The difficulty index of an item is the proportion of all points awarded from the item to the maximum possible points that could be awarded from the item. Ranges from 0 to 1; expressed as a proportion or a percentage.

Some suggest it should be called the ***item easiness index*** instead of the ***item difficulty index*** (but this never really caught on). Often referred to as the item's p-value.

You may have seen the definition as: the proportion of students who answered the item correctly to the total number of students. But this is only valid when all items are worth exactly one point each. This is referred to as 0-1 (zero-one) scoring – an incorrect response is worth zero points, a correct response is worth one point. No partial credit.

Item Discrimination

Generically, it's the relationship (the correlation) between the students' performance on the item and the students' proficiency in the content the item measures. The item should discriminate between the proficient student and the non-proficient student: proficient students should do well on the item, non-proficient students should not do well.

But how do we know if a student is proficient? Appears to be a little circular reasoning here because we administer the item to determine if the student is proficient in the content. Well, if we had some external indicator of student proficiency, we could use that. But, traditionally, we use the actual students' scores on the entire exam as our measure of student proficiency in the content.

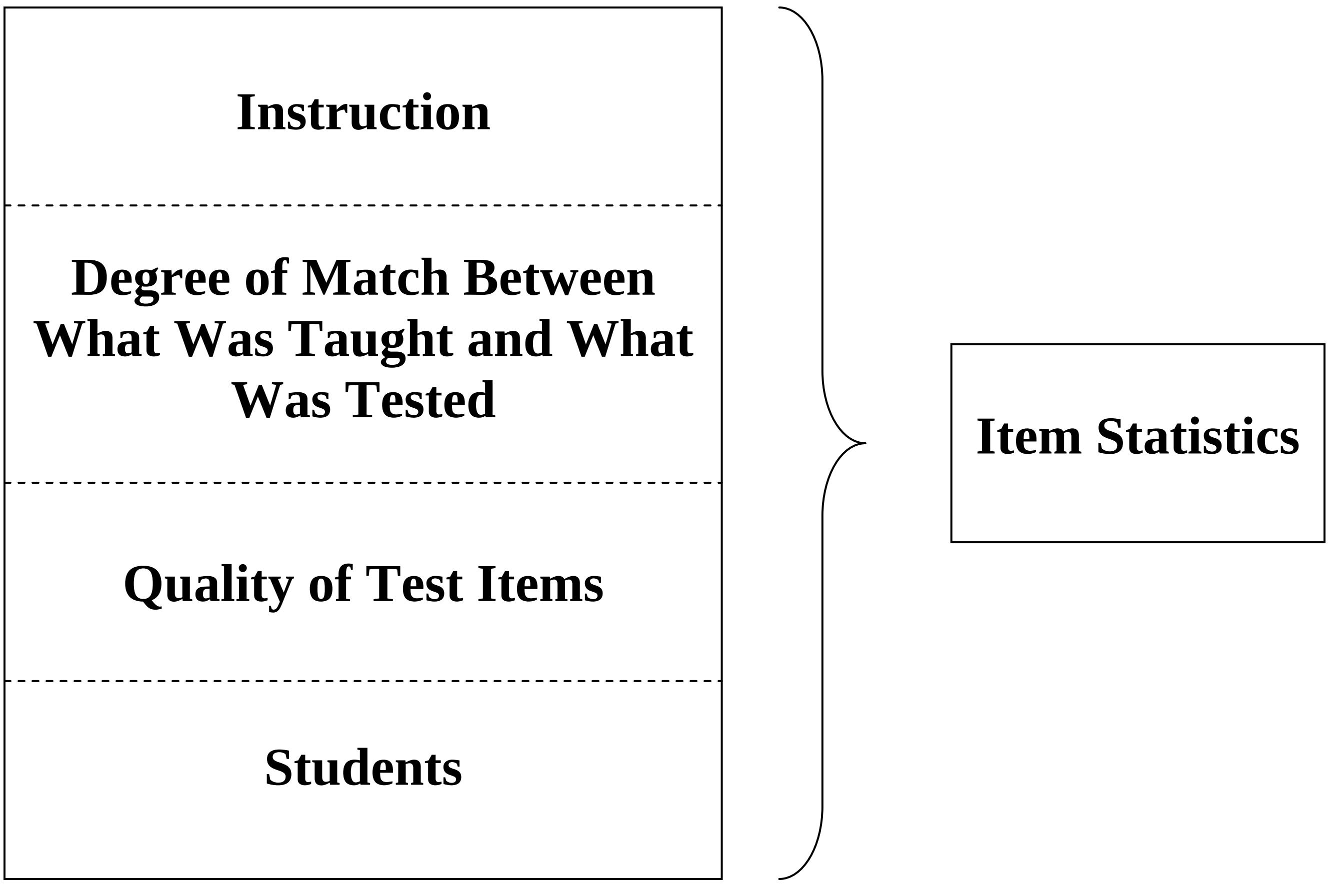
This is a long way of getting to our operational definition of item discrimination. Item discrimination is:

The correlation between students' scores on an item and students' scores on the entire exam. For correlation we use the classic Pearson product-moment correlation coefficient – CORREL( ) in Excel.

Discrimination Demo

Score	Item 38	Score	Item 38	Score	Item 38	Score	Item 38	Score	Item 38	Score	Item 38	Score	Item 38
58	1	57	**0**	58	1	58	1	58	1	58	1	58	1
57	1	57	1	57	1	57	1	57	1	56	**0**	57	1
57	1	57	1	57	1	57	1	57	1	57	1	57	1
57	1	57	1	57	1	57	1	57	1	56	**0**	57	1
57	1	57	1	57	1	57	1	57	1	57	1	57	1
56	1	56	1	56	1	56	1	55	**0**	55	**0**	56	1
55	1	55	1	55	1	55	1	55	1	55	1	55	1
55	1	55	1	55	1	55	1	54	**0**	54	**0**	55	1
55	1	55	1	55	1	55	1	55	1	55	1	55	1
55	1	55	1	55	1	55	1	54	**0**	54	**0**	55	1
55	1	55	1	55	1	55	1	55	1	55	1	55	1
54	1	54	1	54	1	54	1	53	**0**	53	**0**	54	1
54	1	54	1	54	1	54	1	54	1	54	1	54	1
54	1	54	1	54	1	54	1	54	1	53	**0**	54	1
53	1	53	1	53	1	53	1	53	1	53	1	53	1
52	1	52	1	52	1	52	1	52	1	51	**0**	52	1
52	1	52	1	52	1	51	**0**	52	1	52	1	52	1
50	1	50	1	50	1	49	**0**	50	1	50	1	50	1
50	**0**	51	1	51	1	50	**0**	51	1	51	1	51	1
50	1	50	1	50	1	49	**0**	50	1	50	1	50	1
49	1	49	1	49	1	48	**0**	49	1	49	1	49	1
49	1	49	1	49	1	48	**0**	49	1	49	1	49	1
49	1	49	1	49	1	48	**0**	49	1	49	1	49	1
49	1	49	1	49	1	48	**0**	49	1	49	1	49	1
48	1	48	1	48	1	48	1	48	1	48	1	47	**0**
48	1	48	1	48	1	48	1	48	1	48	1	48	1
48	1	48	1	48	1	48	1	48	1	48	1	47	**0**
47	1	47	1	47	1	47	1	47	1	47	1	47	1
47	1	47	1	47	1	47	1	46	**0**	47	1	46	**0**
47	1	47	1	47	1	47	1	47	1	47	1	47	1
46	1	46	1	46	1	46	1	45	**0**	46	1	45	**0**
46	1	46	1	46	1	46	1	46	1	46	1	46	1
46	1	46	1	46	1	46	1	45	**0**	46	1	45	**0**
46	1	46	1	46	1	46	1	46	1	46	1	46	1
45	1	45	1	45	1	45	1	44	**0**	45	1	44	**0**
45	1	45	1	45	1	45	1	45	1	45	1	45	1
44	1	44	1	44	1	44	1	44	1	44	1	43	**0**
44	1	44	1	44	1	44	1	44	1	44	1	44	1
41	1	41	1	41	1	41	1	41	1	41	1	40	**0**
39	1	39	1	38	**0**	39	1	39	1	39	1	39	1
Disc. =	**0.01**	**Disc. =**	**-0.23**	**Disc. =**	**0.40**	**Disc. =**	**0.12**	**Disc. =**	**0.06**	**Disc. =**	**-0.43**	**Disc. =**	**0.54**
Diff =	0.98	Diff =	0.98	Diff =	0.98	Diff =	0.80	Diff =	0.80	Diff =	0.80	Diff =	0.80

Factors Affecting Item Statistics



AHP Exam 1 – Item Analysis Results for Class Discussion

The following items were interesting for one reason or another. Three of them, as indicated, were not included in the computation of scores; they were essentially removed from the exam making the total possible points 52 instead of 55. The three items that were removed had item difficulty values of 40% or less. Almost all of the other items (those not included here) had item difficulty values of 70% or greater, i.e., they were answered correctly by 70% of the class.

This item shouldn't have been difficult, but several students missed it.
Answered incorrectly by six students (item difficulty = 54%):

1. Compute: $\underbrace{7(2\cdot 6\div 3)}-\underbrace{\sqrt{3^2\cdot 2(10-2\cdot 3)-2\cdot 4}}+\underbrace{10\div(2+3)-1}$

$28 \quad - \quad 8 \quad + \quad 1 \quad = \quad 21$ **Answer: 21**

The performance of this item tells me I didn't teach the concept very well.
<u>(Not included in scores.)</u> Answered incorrectly by nine students (item difficulty = 31%):

3. A person's age is an example of which type of measurement scale? (Circle one.)

Nominal Ordinal Interval Ratio

Shouldn't have been difficult; temperature is discussed explicitly on page 8 in the textbook.
Answered incorrectly by five students (item difficulty = 62%):

4. A person's body temperature in Celsius is an example of which type of measurement scale?

Nominal Ordinal Interval Ratio

This turned out to be a very complicated way to test for comprehension of the concept of a biased statistic. It didn't work!
<u>(Not included in scores.)</u> Answered incorrectly by nine students (item difficulty = 31%):

10. When we compute each standard deviation, *s*, of an infinite number of samples of size n from a population with mean μ and standard deviation σ we divide the SS by (n −1) instead of by n. But when we compute the mean, $\overline{X}$, of each sample we divide the sum of scores by n instead of by
(n −1). By using these divisors we ensure that

a. the mean of all sample means is μ and the mean of all sample standard deviations is σ.
b. the mean of all sample means is μ and the mean of all sample standard deviations is less than σ.
c. the mean of all sample means is μ and the mean of all sample standard deviations is greater than σ.

d. the mean of all sample means is less than μ and the mean of all sample standard deviations is less than σ.

e. the mean of all sample means is greater than μ and the mean of all sample standard deviations is greater than σ.

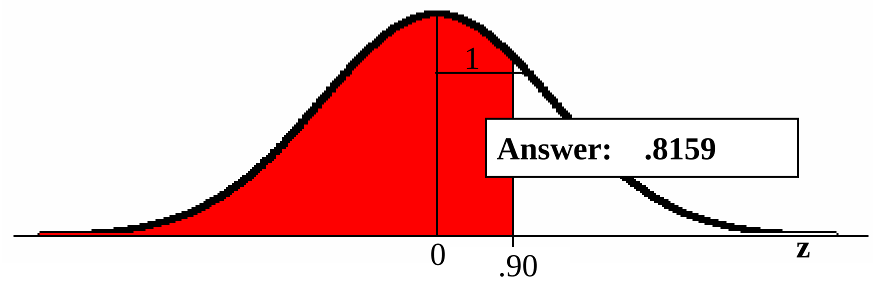
Several students placed the z-score to the *left* of 0, when it should be to the right. Same for item 23.

Answered incorrectly (or partially incorrectly) by five students (item difficulty = 69%):

22. In a standard normal distribution what is the probability of obtaining a z score less than .90?

Prob = .50 + area to .90

= .50 + .3159 = .8159



Complicated, yes. But I believe there was an appropriate amount of practice. So what happened?

Answered incorrectly (or partially incorrectly) by eleven students (item difficulty = 54%):

24. If, in a standard normal distribution, the probability of obtaining a z score between .67 and another z score greater than .67 is .20 (20%), what is the other z score?

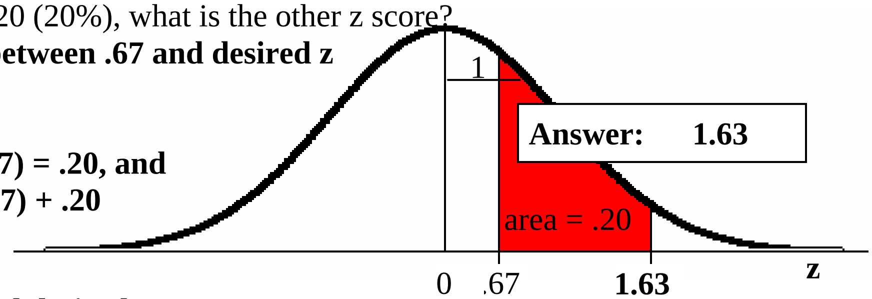
Area to z = .67 is .2486; Area between .67 and desired z must be .20

Therefore:

(area to desired z) – (area to .67) = .20, and

(area to desired z) = (area to .67) + .20

= .2486 + .20 = .4486



Using area in table of .4484, and desired z = 1.63.

Window dressing is usually inappropriate but I wanted you to discriminate among the data provided. Most didn't!

<u>(Not included in scores.)</u> Answered incorrectly by twelve students (item difficulty = 8%):

37. In the regression of Y on X in a sample of 1000 subjects the following data were obtained: S_X = 13.5, r_{XY} = .70, and the standard deviation of the conditional distribution of Y scores at each X score is 4.28. What is the value of the standard error of estimate?

Answer: 4.28

The standard deviation of the conditional distribution of Y scores at each X score is, by definition, the standard error of estimate. All of the other data presented is just window dressing.

This is a good item – requires you to *think*, as do many of the items. Maybe some thought too much!

Answered incorrectly by seven students (item difficulty = 46%):

38. If, in a sample of 400 subjects, the correlation between variables T and U is (+0.62) and the correlation between variables V and U is (−.75) then

    a. the regression of U on T will be *more* accurate with *smaller* errors of estimate than the regression of U on V.
    b. the regression of U on T will be *less* accurate with *larger* errors of estimate than the regression of U on V.
    c. the regression of U on T will be *more* accurate with *larger* errors of estimate than the regression of U on V.
    d. the regression of U on T will be *less* accurate with *smaller* errors of estimate than the regression of U on V.

Item Analysis Example

1. Enter label information

   Item labels & Points Possible for each item – across columns.
   Student ID codes – down rows.
   [Reformat as needed, e.g., column widths – row heights.]

2. Enter raw data – points obtained by each student for each item.
   (From the raw data sheet.)

3. Enter marginal information to the right – down rows:
   <u>Totals Across Items (Student Scores)</u>.

   Total points possible (max score possible on the test).
   Student scores (sum of the item scores for each student).
   Percents.

4. Enter marginal information across the bottom – across columns.
   <u>Total Across Students (Item Scores)</u>.

   Total Points Possible (max score possible for each item).
   Item Scores (sum of the student scores for each item).
   Percents, or proportions (Item Difficulty indices).

5. Enter overall totals in lower right corner.

   Sum of student scores.
   Sum of item scores.
   Max possible test points (either sum of max item scores or
   # students * max test score).
   Percents.

6. Enter Item Discrimination indices in the lower margin – across columns.

Purposes of Item Analysis

Item Analysis can:

1. Provide information (item difficulty and discrimination indices) about the characteristics of each item and how the items are functioning

2. Provide a basis for an informative class discussion of the test results.

3. Identify gaps in student preparation – areas needing possible remediation.

4. Identify gaps in instruction (or even the broader curriculum).

5. Identify items needing revision or elimination.

6. Improve the instructor's test construction skills.

Reliability and the Standard Error of Measurement

Reliability basically refers to the *consistency* with which a test measures whatever it measures. (Validity addresses whether the test measures what it is intended to measure.)

Three basic types of reliability:

<u>Stability Reliability</u> – consistency over time. Also called test-retest reliability. Administer the test twice to the same students. Reliability is obtained by correlating the scores from the two administrations.

<u>Alternate Forms Reliability</u> – consistency over test forms. When you have two forms of the same test administer both forms to the same students. Reliability is obtained by correlating the scores from the two forms

<u>Internal Consistency</u> – the extent to which the items in a test are internally consistent, homogeneous, measure the same general construct. There are various formulas: KR20, KR21, Alpha,… . All yield similar results.

The **<u>Standard Error of Measurement</u>** is based on the reliability index and the variation of the total test scores for the group of examinees who took the test. The formula is:

$$SEM = (TotalTestVariance)\sqrt{1 - reliability}$$

This is interpreted as the amount of error expected in the score from a single student. Statistically, it is the standard deviation of the scores obtained if we could measure a single student over and over and over. If we assume that this large (infinite) number of scores is normally distributed, then we can develop confidence intervals for the student's *true* score:

68% Confidence Interval = [(Student's Obtained Score) ±1SEM]

95% Confidence Interval = [(Student's Obtained Score) ±2SEM]

99% Confidence Interval = [(Student's Obtained Score) ±3SEM]

	Test with only one item			**Test with only two items**		
	Item Scores (25 pts.)	Total Test Scores		Item 1 Scores (20 pts.)	Item 2 Scores (20 pts.)	Total Test Scores
Students			Students			
A	19	19	A	20	18	38
B	22	22	B	18	18	36
C	18	18	C	13	15	28
D	16	16	D	13	17	30
E	25	25	E	16	18	34
F	23	23	F	18	19	37
G	14	14	G	15	15	30
H	20	20	H	16	16	32
I	21	21	I	14	16	30
J	15	15	J	17	16	33
K	17	17	K	19	18	37
L	19	19	L	16	17	33
M	24	24	M	14	13	27
	Item Discrimination			Item Discrimination		
	1.00			0.94	0.89	
	= CORREL( )					

ITEM and TEST DEVEOPMENT

CEET Faculty Development Program

The Scholarship of Teaching

Student Assessment Program Component

Suggestions for Constructing Multiple Choice Items

1. The stem of the item should be meaningful by itself and should present a definite problem.

2. The item stem should include as much of the item as possible and should be free of irrelevant material.

3. Use a negatively stated stem only when significant learning outcomes require it.

4. All the alternatives should be grammatically consistent with the stem of the item.

5. An item should contain only one correct or clearly best answer.

6. Items used to measure understanding should contain some novelty, but beware of too much.

7. All distracters should be plausible. The purpose of a distracter is to distract the uninformed from the correct answer.

8. Verbal associations between the stem and the correct answer should be avoided.

9. The relative length of the alternatives should not provide a clue to the answer.

10. The correct answer should appear in each of the alternative positions an approximately equal number of times but in random order.

11. Use sparingly special alternatives such as “none of the above” or “all of the above.”

12. Do not use multiple-choice items when other item types are more appropriate.

From

Linn, Robert L., Miller, M. David (2005). *Measurement and Assessment in Teaching* (9^{th} ed.). New Jersey: Pearson Prentice Hall

Test Development

Housekeeping and Test Analysis Posttest

Broad, Four-Day Schedule:

Today, 3/30/06:	Introduction to Objective Items & Item Writing
4/6/06:	Item Writing
4/20/06:	Item Writing (And Test Development?)
4/27/06	Test Development – Midterm and Final

Today's Schedule:

Why Use Many Discrete, Objectively-Scored Items?

Taxonomies Revisited

Classify Test Items According to Bloom's Taxonomy

One of My Statistics Tests (It's good, but not perfect)

What is <u>A Valid Test Item</u>

Suggestions for Constructing Multiple Choice Items

Write MC Items

Suggestions for Constructing Short Answer, True-False and Multiple True-False It

Write Short Answer, TF, and MTF Items

Write Items – Any Type Discussed Today, Or Variations

Print Out Items for Me (or Send to jsgilmer@niu.edu)

Why use many discrete, objectively-scored items instead of fewer essay or performance-type items?

Advantages of Objective Items:

1. Better Content Coverage (Improves Test Validity and Reliabi
2. Scoring is Objective, not Subjective (Improves Test Reliabili
3. Scoring is Efficient and Easy, Often Can Be Machine Scored

Disadvantages of Objective Items:

1. Require Time to Develop
2. Hard to Assess Higher Order Thinking or Performance
3. Guessing

Teaching Models

Teaching Styles

Learning Styles

TESA

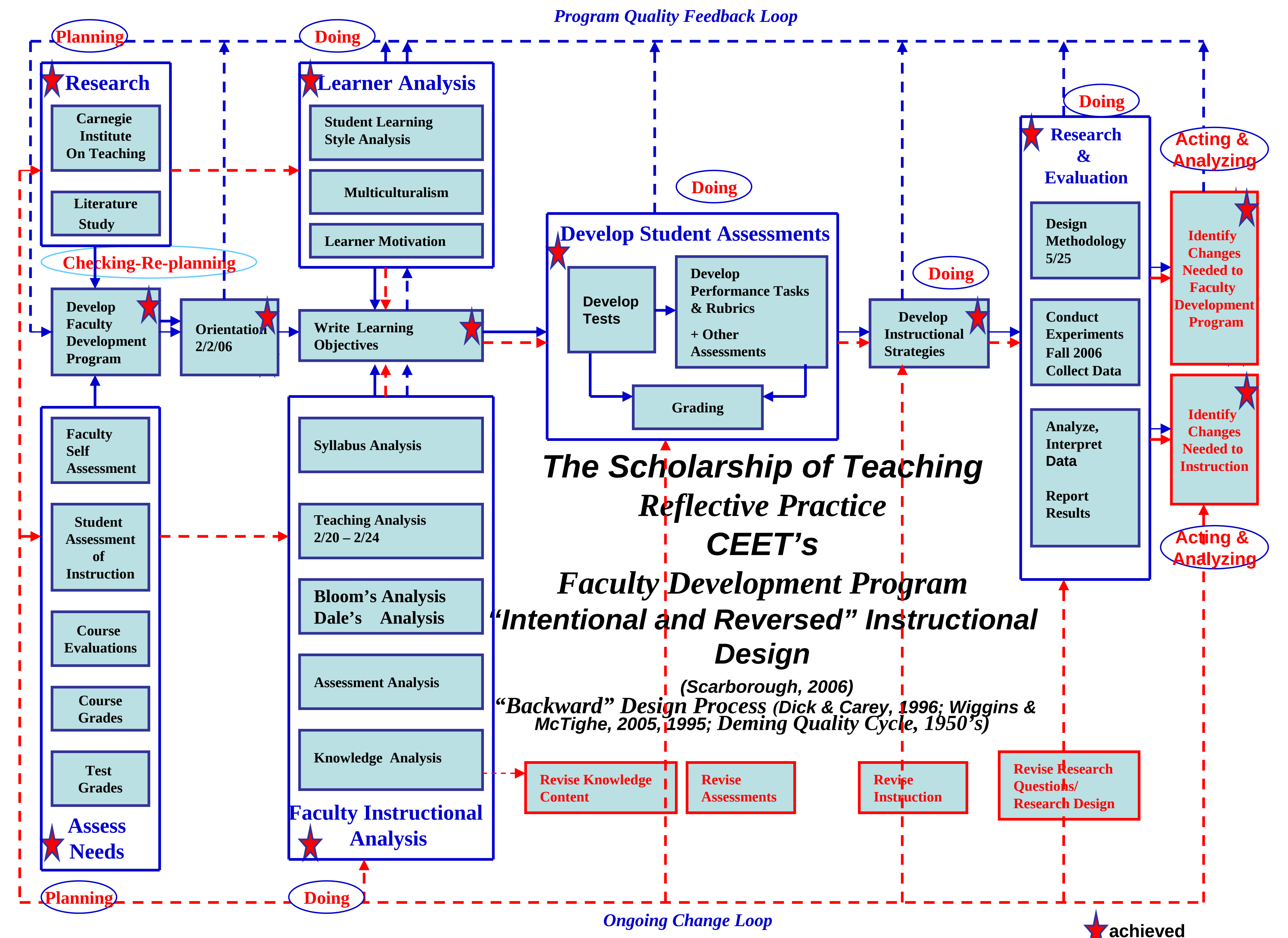
Jule Scarborough, 2006; some content based upon J.Parker, 2001

(for PowerPoint presentations, contact julescarborough@niu.edu)

Table 1.5 A Summary of The Seven Principles of Good Practice

Principle	Behavioral indices
Good practice encourages student—faculty contact: Frequent contact in and out of classes	Remembering students' names Involving students in lab and field research projects Taking students to conventions, regional conferences Disclosing personal values, when appropriate Attending student-sponsored events Mentoring and informal advising
Good practice encourages cooperation among students: Collaborative, noncompetitive learning in small groups and student-to-student networks	Encouraging self-disclosure to one another Facilitating the formation of study groups Assigning group projects Using peer evaluation techniques when grading Teaching through group discussion Promoting student-to-student tutoring/teaching Grading by criteria and not by interstudent comparison
Good practice encourages active learning: Teaching methods that require more than passive listening and note taking from students	Requiring class presentations Assigning papers and projects that promote critical thinking Asking students to integrate contemporary events with course material, discussing real-life cases, etc. Assigning term projects and independent studies Involving students in research
Good practice gives prompt feedback: Assessment of baseline knowledge, frequent testing of progress in learning, and global assessment of educational outcomes	Giving quizzes and homework assignments Returning examinations and papers within a week Providing feedback to students early in the term Writing comments on exams and papers Pretesting students Calling or e-mailing students who miss classes
Good practice emphasizes time on task: Setting appropriate time demands and helping students learn to manage their time	Establishing deadlines for completing assignments Discussing course demands with students Helping students set challenging goals Encouraging practice runs before oral reports Stressing self-regulation, studying, and attendance Meeting with students who fall behind Warning students about time commitment to the course
Good practice communicates high expectations: Setting reasonable but high standards for achievement	Stressing high standards of achievement Establishing performance expectations orally and in writing Helping students set challenging goals Explaining penalties for missed or late work Assigning writing Calling attention in class to excellence by class members
Good practice respects diverse talents and ways of learning: Providing a variety of learning experiences and assessment options	Encouraging questions Discouraging off-task, divisive comments Using a variety of teaching methods Discussing the contributions of women and minority psychologists Developing and using alternative teaching methods Exploring students' backgrounds, learning styles, and outlooks

Chickering & Gamson (1987)



Jule Scarborough, 2006

Brain Research (Jensen, 1998, Tomlinson, 1999)

- The brain seeks meaningful patterns and resists meaninglessness
- It retains isolated or disparate bits of info. but it is much more efficient at retaining information that is “chunked”
- Responds much more effectively and efficiently to something that carries deep and personal meaning, something that is life shaping, relevant, important, or taps into emotions

- Students need to be optimally challenged with activities that ask them to risk a leap into the unknown, but they know enough to get started and have additional support for reaching a new level of understanding

☺		☹
Increase intrinsic motivation		Increase apathy and resentment
CHOICES	**VS**	**REQUIRED**
Provide choices: content, timing, work partners, projects, environment, or resources		Directed 100%, no student input, resources restricted
RELEVANT	**VS**	**IRRELEVANT**
Make it personal: relate to family, neighborhood, city, life stages, love, health, etc		Impersonal, useless, out of context, and only done to pass a test
ENGAGING	**VS**	**PASSIVE**
Make it emotional, energetic; make it physical; use learner-imposed deadlines		Disconnected from the real world, low interaction, lecture, seatwork, or video

Jensen, 1998, Pg. 48

Jule Scarborough, 2006; some content based upon J.Parker, 2001

Qualities of Genius (Armstrong, 1998)

- Curiosity
- Playfulness
- Imagination
- Creativity
- Wonder
- Wisdom
- Inventiveness
- Vitality
- Sensitivity
- Flexibility
- Humor
- Joy

How Genius Shuts Down

- Role of the Home
  - Emotional dysfunction
  - Poverty
  - Fast track lifestyles
  - Rigid ideologies

How Genius Shuts Down

- Role of the School
  - Testing and grading
  - Labeling and tracking
  - Textbooks and worksheet learning
  - Tedium

How Genius Shuts Down

- Role of the Popular Media
  - Stereotypical images
  - Insipid language
  - Mediocre content

Awakening Genius in the Classroom

- Re-awaken genius in yourself
- Create a genial classroom climate
  – Freedom to choose
  – Open-ended exploration
  – Freedom from judgment
  – Honoring every student’s experience
  – Belief in every child’s genius
- Genius is expressed in different ways

How do students express their genius?

Multiple Intelligences

(Gardner, 1983, Campbell, Campbell, & Dickinson, 1999)

- Much research has been done and drawn several conclusions:
  - We think, learn, and create in different ways
  - Development of our potential is affected by the match between what we learn and how we learn with our particular intelligences
  - Intelligence is multifaceted, not singular
  - Intelligence is fluid and not fixed

Verbal/Linguistic

Verbal/Linguistic

- Ability to think in words and to use language to express and appreciate complex meaning

- Words, wordsmiths, speaking, writing, listening, reading, papers, essays, poems, plays, narratives, lyrics, spelling grammar, foreign language, memos, bulletins, newsletters, newspapers, FAXes, E-mail,dialogues, debates.

- Authors, poets, journalists, speakers, newscasters

Logical/Mathematical

Logical/Mathematical

- Makes it possible to calculate, quantify, consider propositions, and hypotheses, and carry out complex mathematical operations

- Reasoning, deductive and inductive logic, facts, data, information, spreadsheets, databases, sequencing, ranking, organizing, analyzing, proofs, conclusions, judging, evaluations, and assessments

- Scientists, accountants, engineers, programmers

Visual/Spatial

Visual/Spatial

- Instills the capacity to think in three dimensional ways. Enables one to perceive external and internal images, to produce or decode graphic information

- Images, graphics, drawings, sketches, maps, charts, doodles, pictures, designs, imagination, visualization, dreams, films, cartoons

- Sailors, pilots, sculptors, painters, architects

Bodily/Kinesthetic

Bodily/Kinesthetic

- Enables one to manipulate objects and fine tune motor skills. Ability to unite body and mind. Foundation of human knowing as we experience life through our sensory-motor experiences

- Experiential, hands-on, actions, play, touch, manipulate, games, field trips, drama, sports

- Dancers, athletes, surgeons, physical educators

Musical/Rhythmic

Musical/Rhythmic

- Sensitivity to pitch, melody, rhythm, and tone.
- Music, rhythm, pacing, tenor, choir, songs, jingles,
- Composers, sensitive listeners, conductors, musicians

Interpersonal

Interpersonal

- Capacity to understand and interact effectively with others. Operates primarily through person-to-person relationships and communication
- Interact, laugh, whisper, empathize, sympathize, group projects, debates, dialogues
- Teachers, social workers, actors, counselors

Intrapersonal

Intrapersonal

- Ability to construct an accurate perception of oneself and to use such knowledge in planning and directing one's life

- Self-reflection, logs, journals, poetry, meditations, creative expression

- Psychologists, theologians, philosophers, parents

Naturalistic

- Recognition, appreciation, and understanding of patterns in nature. Understanding natural and human-made systems

- Field trips, nature walks, ecological studies, plant identification, weather forecasting

- Botanists, farmers, zoologists, landscapers

Content of a Healthy Classroom

- relevant to students, personal and seems familiar, connected to the world they know
- helps students understand themselves and their lives more fully now, and will continue to do so as they grow

Content of a Healthy Classroom

- authentic, offering “real” history etc not just exercise about the subject
- can be used immediately for something that matters to the students
- makes students more powerful in the present and the future

Creating a Healthy Classroom

- Appreciate each child as an individual
- Teach the child as a whole
- Continue to develop expertise
- Link students and ideas
- Strive for joyful learning

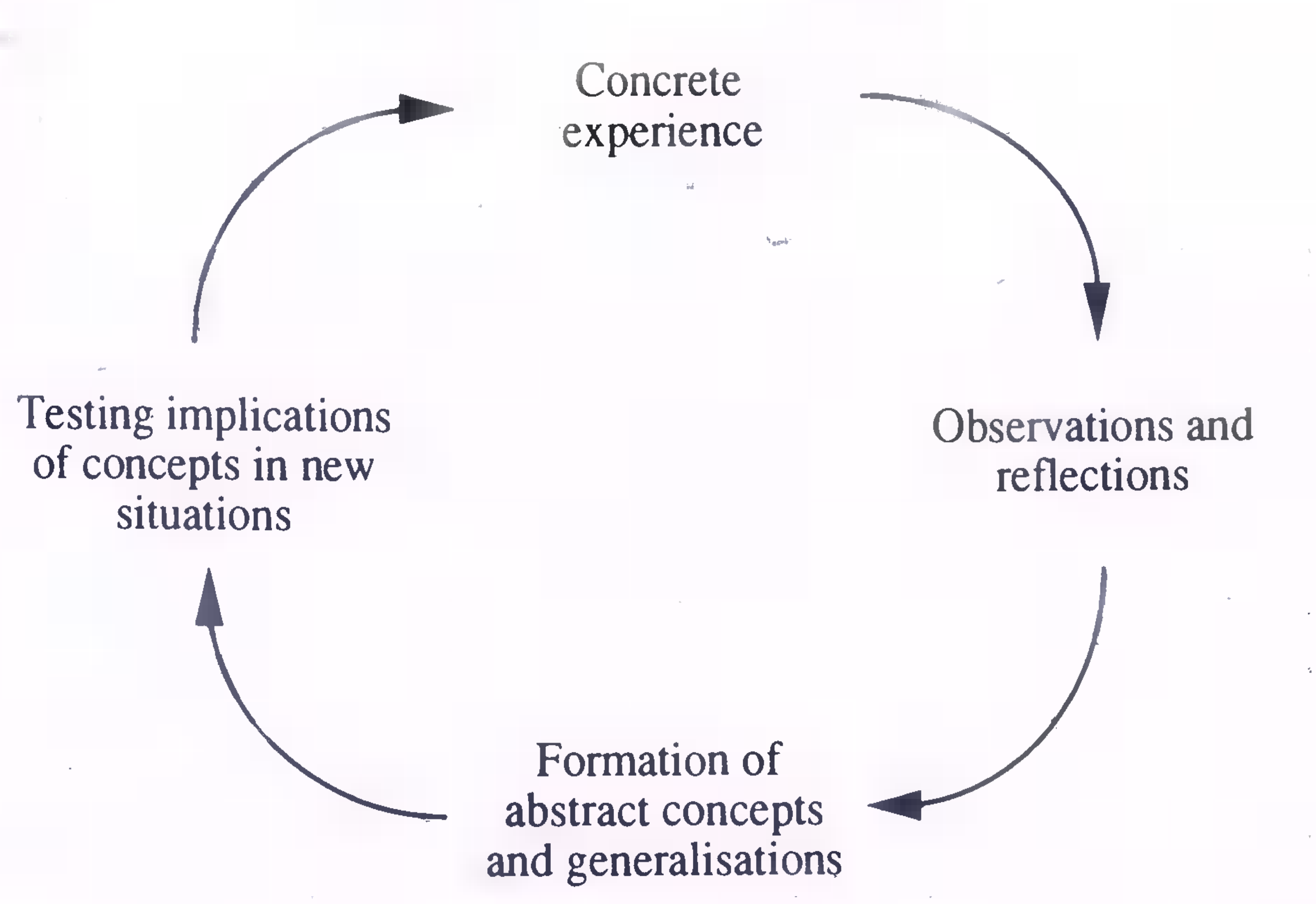
Creating a Healthy Classroom

- Help students make sense of their own ideas
- Share teaching with students
- Strive for student independence
- Use positive energy and humor
- Discipline is more covert than overt

Learning Styles (David A. Kolb, 1999)

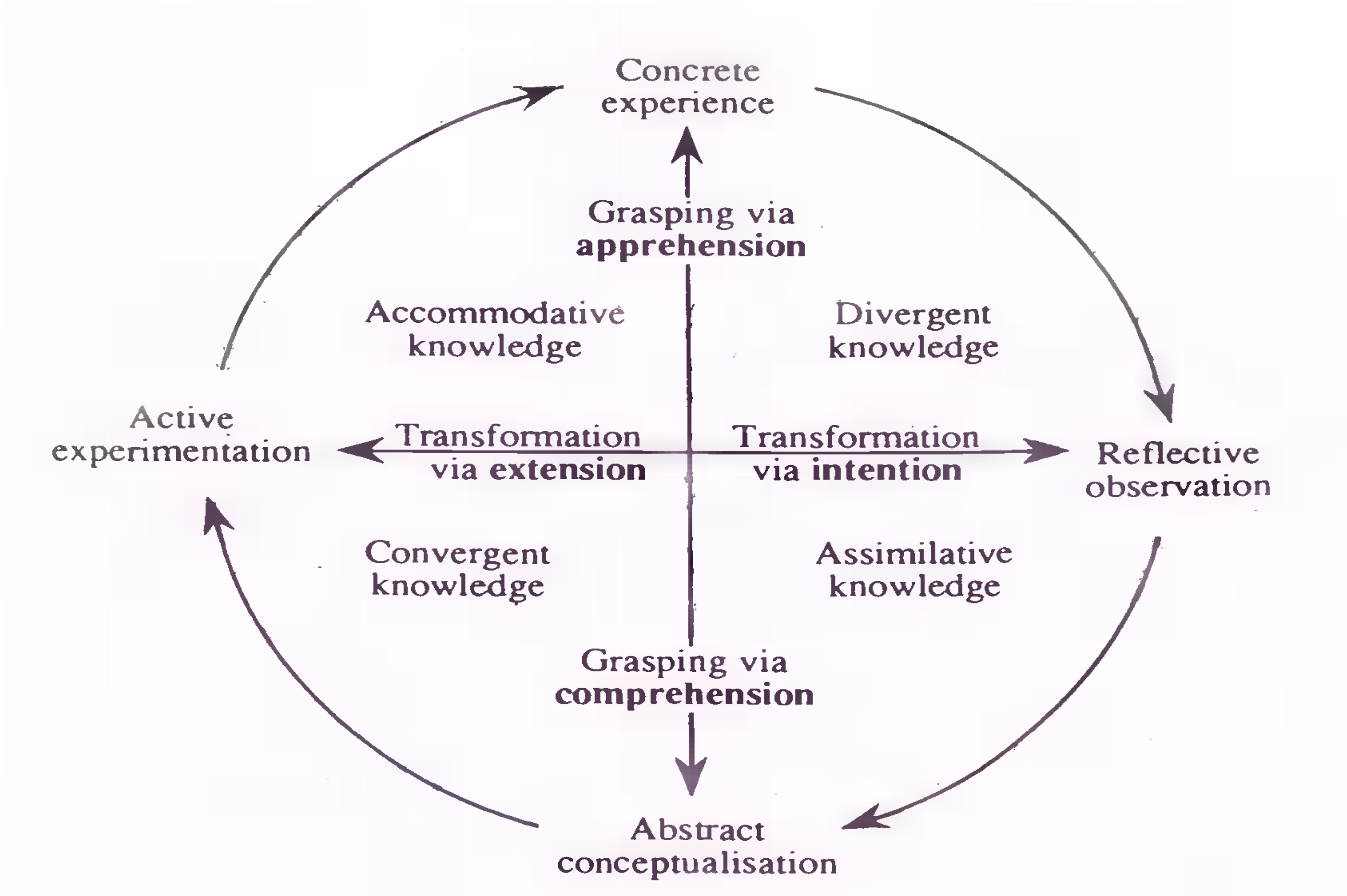
- Two ways to take in experiences
  – Concrete Experience (Feeling)
  – Abstract Conceptualization (Thinking)
- Two ways to deal with experiences
  – Active Experimentation (Doing)
  – Reflective Observation (Reflecting)

The Lewinian Experiential Learning Model



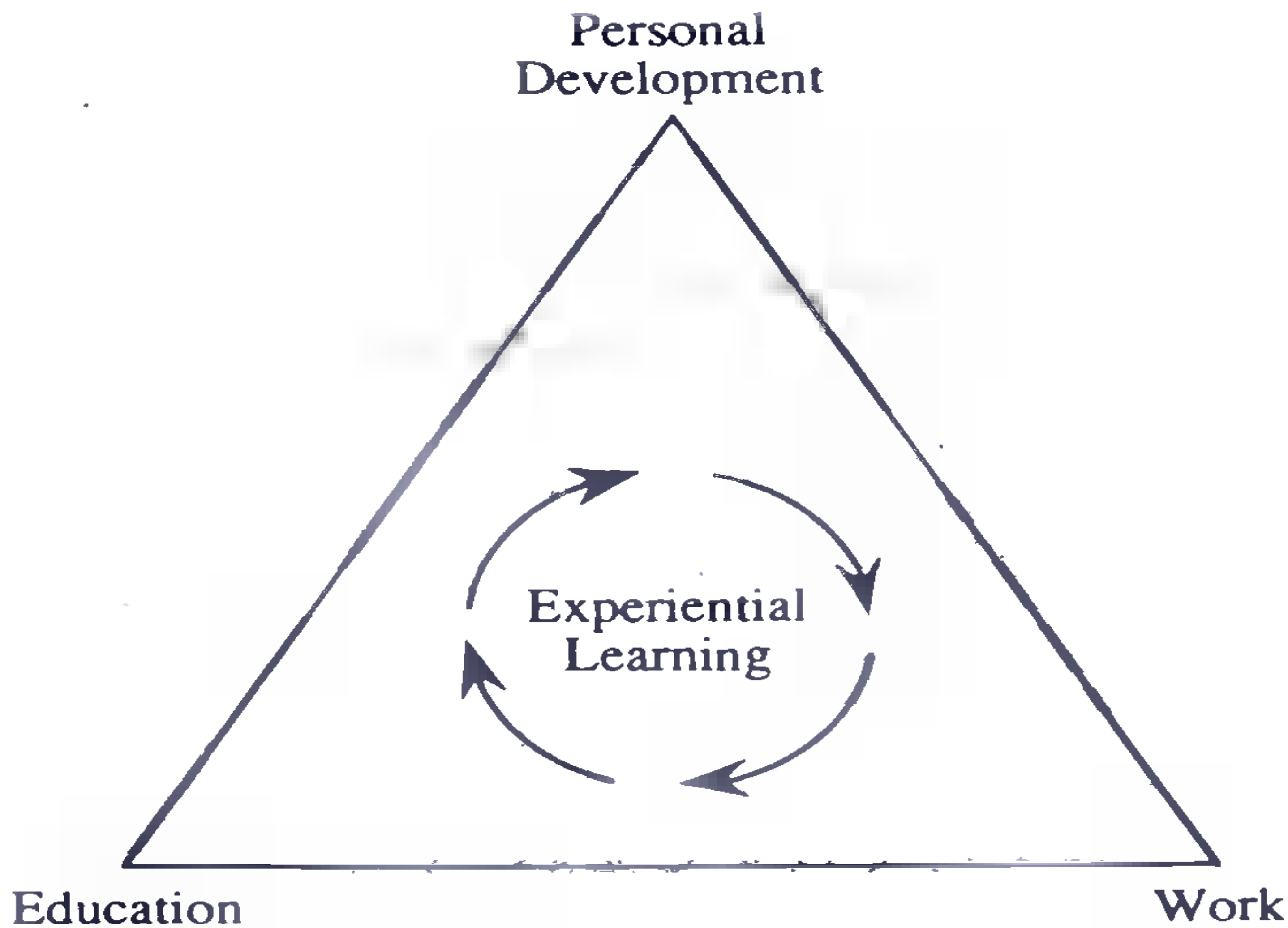
Kolb (1984) p.21

Kolb's Model of Experiential Learning



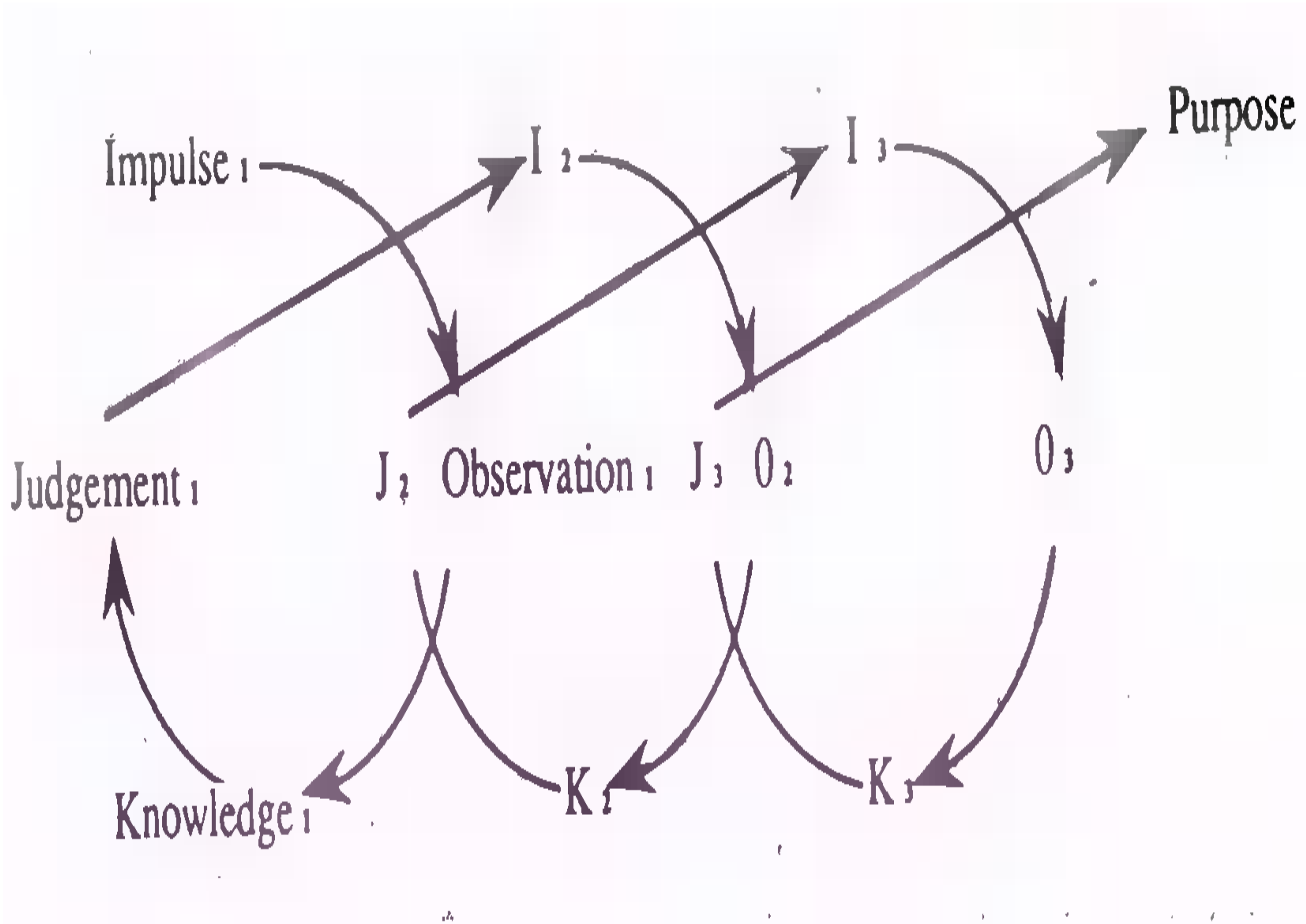
Kolb (1984) p.42

Experiential Learning as the Process That Links Education Work and Personal Development



Kolb (1984) p.4

Dewey's Model of Experiential Learning



Kolb (1984) p.23

Experience (Feeling)

- Learning by experiencing
  – Learning from specific experiences
  – Relating to people
  – Being sensitive to feelings and people
- Learning Situations
  – New experiences, games, role plays
  – Peer feedback and discussion
  – Personalized counseling

Abstract Conceptualization/Generalizing (Thinking)

- Learning by Thinking
  - Logically analyzing ideas
  - Planning systematically
  - Acting on intellectual understanding
- Learning Situations
  - Theory readings
  - Study time alone
  - Clear, well-structured presentation of ideas

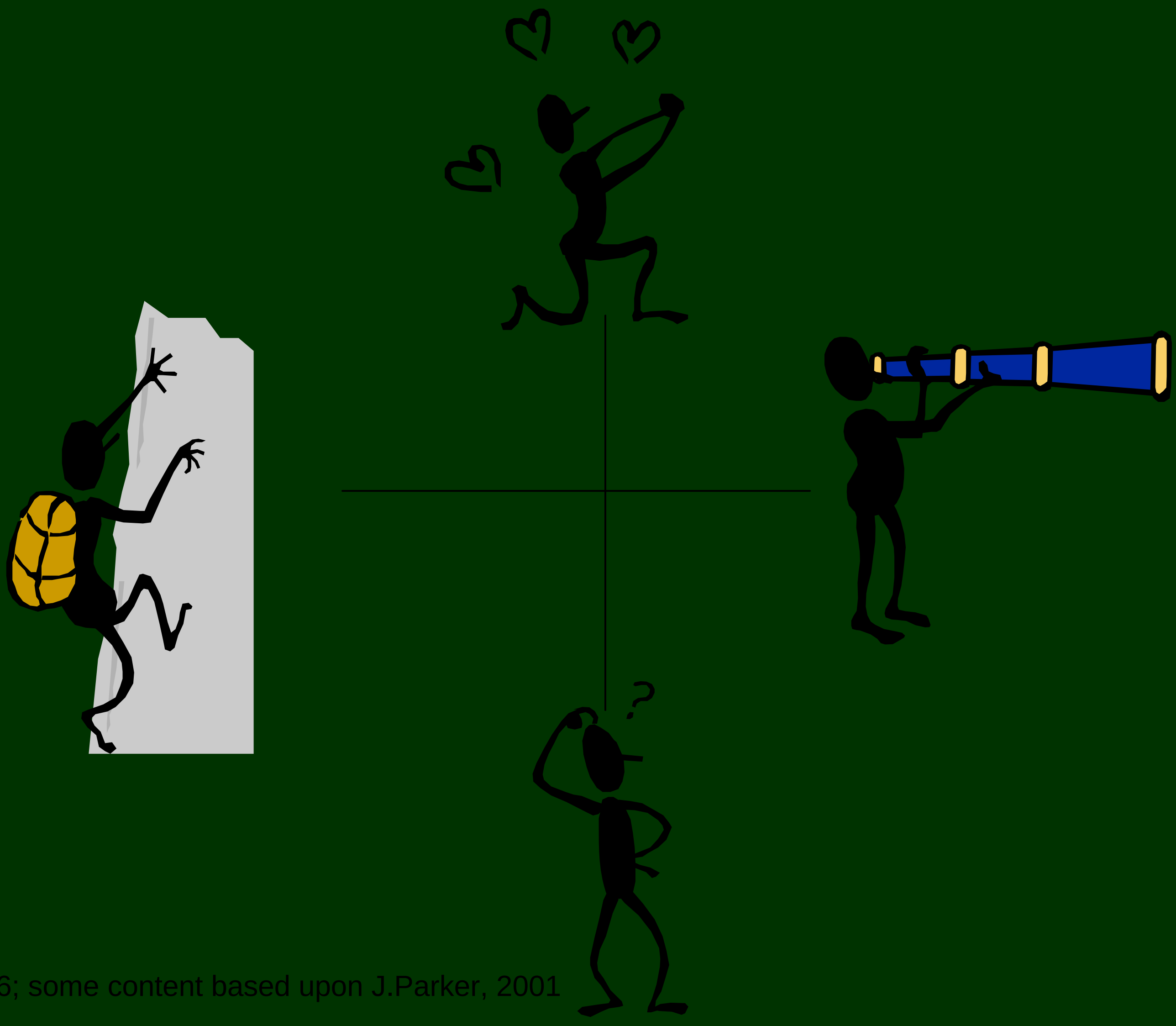
Active Experimentation/Applying (Doing)

- Learning by doing
  - Showing ability to get things done
  - Taking risks
  - Influencing people and events through action
- Learning Situations
  - Opportunities to practice and receive feedback
  - Small group discussions
  - Self-paced learning activities

Reflective Observation (Reflecting)

- Learning by reflecting
  - Carefully observing before making judgments
  - Viewing issues from different perspectives
  - Looking for the meaning of things
- Learning Situations
  - Lectures
  - Opportunities to take observer role
  - Objective tests

Learning Style Quadrants



Jule Scarborough, 2006; some content based upon J.Parker, 2001

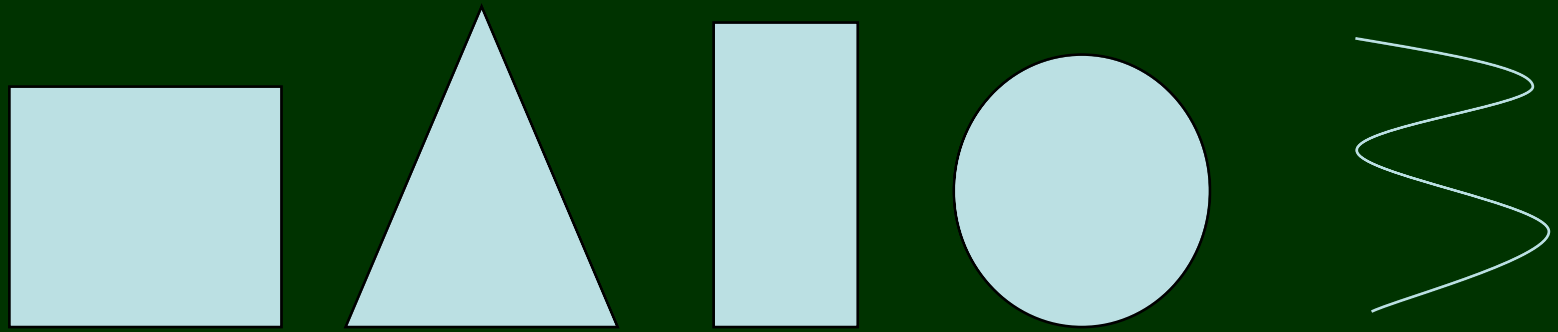
How to Address Learning Styles

- To ensure that all student learning styles are addressed in a class, include the following sections:
    - Experiencing
    - Reflecting
    - Generalizing
    - Applying

Learning Styles - Web Sites

- http://www.learningstyle.com
- http://www.ncsu.edu/felder-public/ILSdir/styles.htm
- http://www.ncsu.edu/felder-public/ILSdir/Zywno_Validation_Study.pdf
- http://www.ncsu.edu/felder-public/Papers/LS-1988.pdf
- http://www.indiana.edu/~intell/map.shtml
- http://www.engr.ncsu.edu/learningstyles/ilsweb.html
- http://www.indstate.edu/ctl/styles/learning.html#LSHE

- Select one shape that is most representative of you - the one you relate to most



Additional Factors

- There are other factors that influence learning
  - Stress: biodot
  - Sleep: teenagers need between 9 and 10 hours of sleep a night

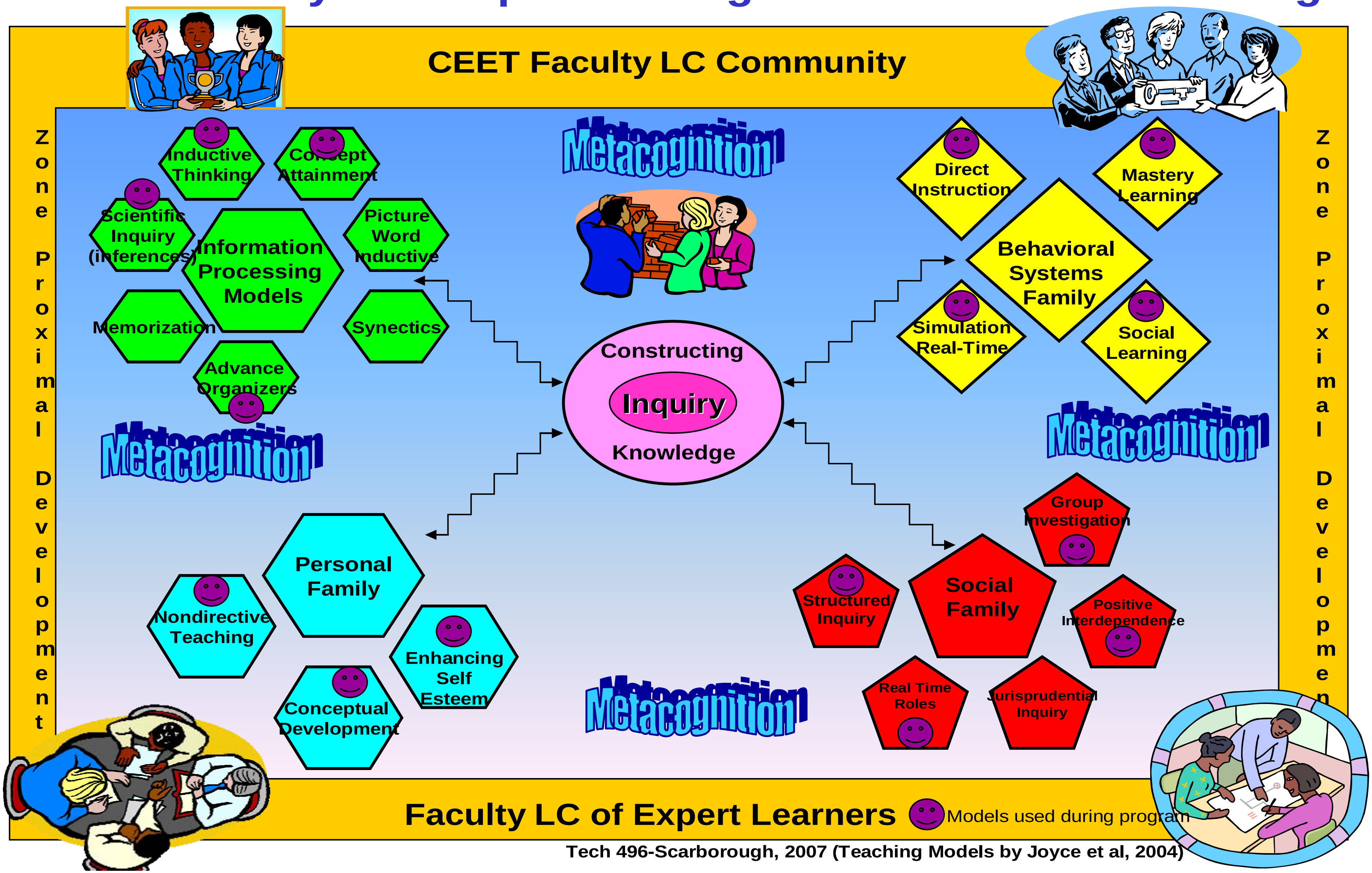
Teaching Styles

- Just as students are smart in different ways and have different learning styles, we also have different teaching styles

Teaching Models

Joyce, b., Weil, M. with Calhoun, E. (2004) Models of Teaching. Seventh Edition.

CEET Faculty Development Program : Models of Teaching



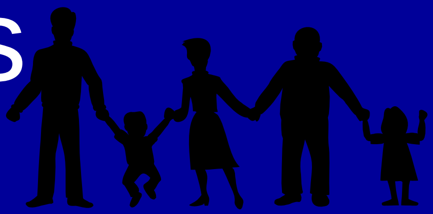
Why Models?

"Structured, logically consistent, cohesive…patterns of teaching" Joyce and Weil (1972)

- Holistic Approach to teaching
- Ties together theory, planning, classroom management, teaching and learning, and assessment

Joyce, b., Weil, M. with Calhoun, E. (2004) Models of Teaching. Seventh Edition.

Families of Models



- Information Processing Family
  - Learning to think by thinking
  - Models that increase students' ability to master and organize information, build and test hypotheses etc

- Personal Family
  - Models that focus on personal identity
  - Promote self-awareness and self-understanding

Families of Models

- Behavioral Systems Family
  - Models that take advantage of our ability to modify behavior in response to tasks and feedback
- Social Family
  - Focus on our social nature and how social interaction can enhance learning

Direct Instruction

- Teacher directed and controlled
- Major goal is to maximize student learning time
- High priority on the assignment and completion of academic tasks
- Atmosphere of relatively neutral affect

Direct Instruction cont.

- Orientation
  - Objective, content relationships, procedures
- Presentation
  - Concept explanation, demonstration
- Structured practice
  - Teacher leads step by step
- Guided practice
- Independent practice

Simulations

- Designed to closely mimic reality
- Complexity can be controlled
- Students become involved in situations similar to real life
- Teacher must raise students' consciousness about underlying concepts and principles
- Popular simulations: Monopoly, SimCity

Simulations cont.

- Orientation
  - Present concept and topics, explain simulation
- Participant training
  - Set up scenario, assign roles
- Simulation operations
  - Conduct activity, obtain feedback, clarify misconceptions, continue
- Participant debriefing

Inductive Thinking

- Students learn information and concepts through the act of classifying
- Students gather and classify information to build and test hypotheses
- A generic model because classification is applicable to many different disciplines

Inductive Thinking cont.

- Concept Formation
  - Enumeration and listing
  - Grouping
  - Labeling, categorizing
- Interpretation of Data
  - Identifying critical relationships
  - Exploring relationships
  - Making inferences

Inductive Thinking cont.

- Application of Principles
  - Predicting consequences, explaining, hypothesizing
  - Explaining and/or supporting hypotheses
  - Verifying prediction

Concept Attainment

- Challenges students to distinguish a concept by comparing and contrasting positive and negative examples
- Students determine the attributes of a category that already exists

Concept Attainment cont.

- Presentation of data and identification of concept
- Testing attainment of concept
- Analysis of thinking strategies

Inquiry

- Helps students inquire independently but in a disciplined manner
- Specializes in causal reasoning, sharpening tools of scientific inquiry
- Teaches students a process for investigating and explaining phenomena
- Based on a conception of scientific inquiry, this model teaches skills and language of scholarly inquiry

Inquiry cont.

- Confrontation with the problem
  - explain inquiry procedures, present discrepant event
- Data Gathering-verification
- Data Gathering-experimentation
  - isolate variables, hypothesize and test
- Formulating an explanation
- Analysis of inquiry process

Advance Organizer

- Helps teachers organize and convey large amounts of information as meaningfully and efficiently as possible
- Helps students become active learners when they receive information through lectures and written assignments
- Primary means of strengthening cognitive structure and enhancing retention of new information

Advance Organizer cont.

- Presentation of advance organizer
  - identify attributes, give examples, provide context, repeat, prompt awareness of knowledge
- Presentation of Task or Material
  - present material, make logical order explicit, link to organizer
- Strengthen Cognitive Organization
  - integrate, elicit critical approach, clarify, apply

Memory/Mnemonics

- Designed to increase the capacity to store and retrieve information
- Helps students develop strategies for acquiring and remembering information
- Systematic procedures for enhancing memory

Memory/Mnemonics cont.

- Attend to material
  - underline, list, reflect etc
- Develop Connections
  - make material familiar using key-words, substitute words, or link-words techniques
- Expand Sensory Images
  - Ridiculous association or exaggeration
- Practice Recall
  - Practice recall until completely learned

Synectics

- Creative problem solving process using irrational analogies to help develop creative, metaphoric and critical thinking
- Teaches metaphoric thinking
- Consciously breaks from routine thinking to generate new ideas
- Syn - bringing together
- Ectics - diverse elements

Synectics - Creating something new

- Description of present condition
- Direct analogy
- Personal analogy
- Compressed conflict
- Direct analogy
- Re-examination of original task

Synectics - Making the strange familiar

- Substantive input
- Direct analogy
- Personal analogy
- Comparing analogies
- Explaining differences
- Exploration
- Generating analogy

Cooperative Learning

- A teaching arrangement of small groups of students working together to achieve a common learning goal
- Emphasizes team spirit rather than individual competition
- Tasks require that students depend on one another

Jurisprudential

- Helps students learn to think systematically about contemporary issues
- Formulates issues as public policy questions to analyze alternative positions about them
- Provides students with tools for analyzing and debating social issues

Jurisprudential cont.

- Orientation to the case
- Identifying the issues
- Taking positions
- Exploring the stance
- Refining and qualifying positions
- Testing factual assumptions behind positions

Role Play

- Exploring problems through action
- Students explore their feelings, attitudes, and values
- Develops problem solving skills
- Offers opportunity to resolve interpersonal and social dilemmas

Role Play cont.

- Warm up group
- Select participants
- Set the stage
- Prepare the observers
- Enact
- Discuss and evaluate
- Reenact
- Discuss and evaluate
- Share experiences and generalize

Non-Directive

The hard part of figuring out how to teach is learning when to keep your mouth closed, which is most of the time

Carl Rogers, about 1960

Non-Directive

- Focuses on facilitating learning
- Teacher-student relationship is more like counselor or learning partner
- Helps students attain greater personal integration, effectiveness, and realistic self-appraisal
- Nurtures students rather than controlling the sequence of learning

Non-Directive cont.

- Defining the helping situation
  - Teacher encourages free expression
- Exploring the problem
  - Student defines, teacher accepts and clarifies
- Developing insight
  - Student discusses problem
- Planning and decision making
  - student plans initial decision making, teacher supports
- Integration

TESA

Teacher Expectation Student Achievement

Jule Scarborough, 2006; some content based upon J.Parker, 2001

TESA Interaction Model

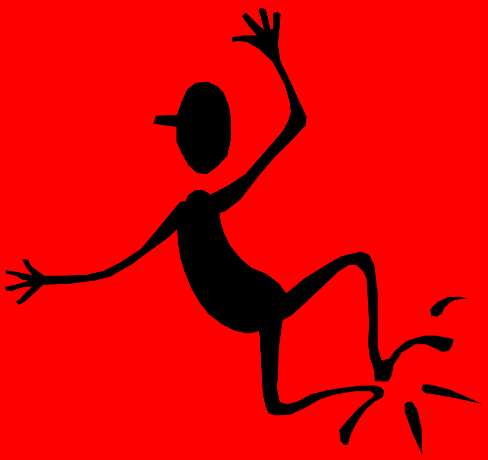
- Five units
- 3 strands
  - A: Response opportunities
  - B: Feedback
  - C: Personal Regard
- Each unit contains a strategy from each strand

(Teacher Expectations and Student Achievement. Los Angeles County Office of Education. Downey, Calilfornia. Los Angeles County Office of Education, 1993.)

Equitable Distribution of Response Opportunities (1)

- Low achievers are less likely to be called on than high achievers
- Teachers call on male students more frequently than female students

Positive



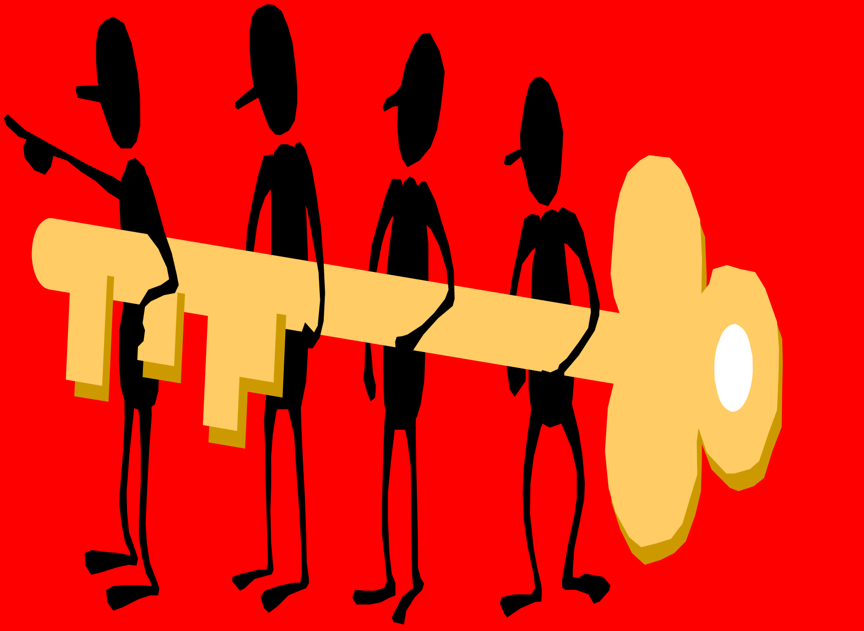
- **When the teacher provides a response opportunity for one of the five students identified as low achievers or one of the five high achievers**

Negative

- **When the teacher unreasonably prohibits a target student from responding or performing**

Affirmation or Correction

- The teacher should acknowledge correct responses, or whatever part of the response is correct, and try to elicit additional or improved information



Positive

- **When the teacher informs the student who has responded to a question that his/her response or work is or is not acceptable**

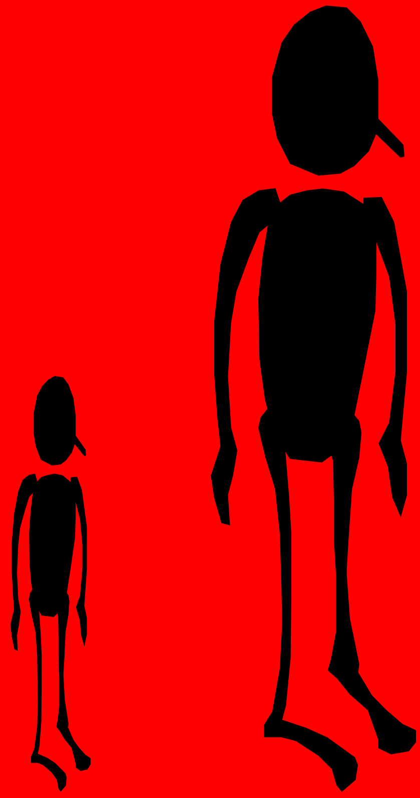
Negative

- **When the teacher does not react or comment after a student has responded to a question**

Jule Scarborough< 2006, some content based upon J.Parker, 2002001

Proximity

- Where the student is seated in the classroom: the nearness of the teacher to students



Positive

- **When the teacher comes within arm’s reach of a target student, whether or not the student is aware of his/her presence**

Negative

- **When the teacher avoids proximity with a target student**

Individual Helping (2)

- To provide academic assistance to one student at a time
- Teachers should try to provide individual help to low achievers as frequently as other students

Positive

- **When the teacher gives individual assistance to a student**

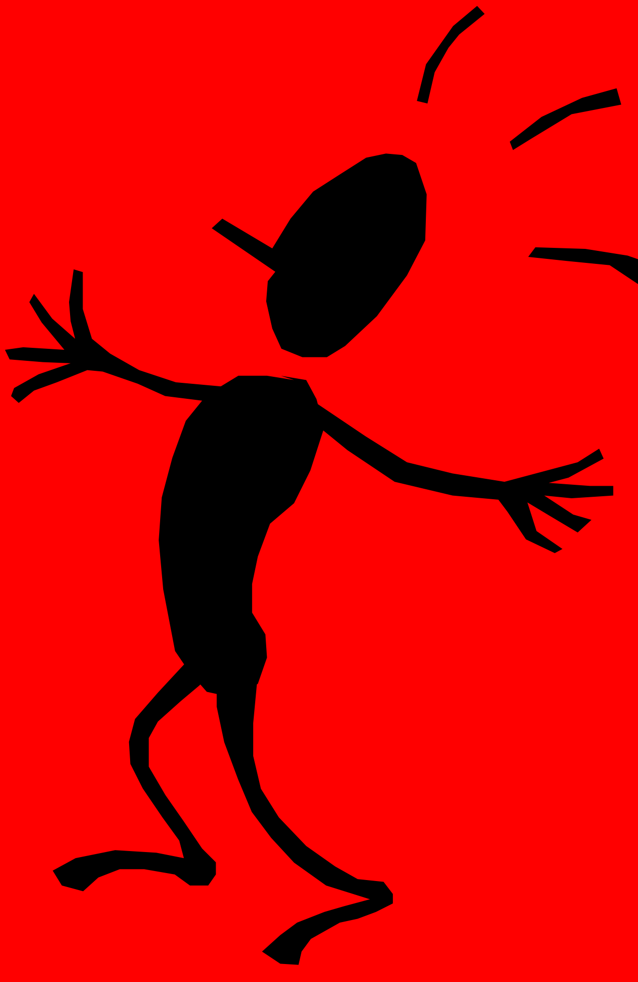
Negative

- **When the teacher ignores the students attempt to obtain teacher help**

Jule Scarborough< 2006, some content based upon J.Parker, 2001

Praise

- Verbal and nonverbal feedback of a student’s performance
- Teachers are less likely to praise perceived low achievers and more likely to criticize them for incorrect public responses



Positive

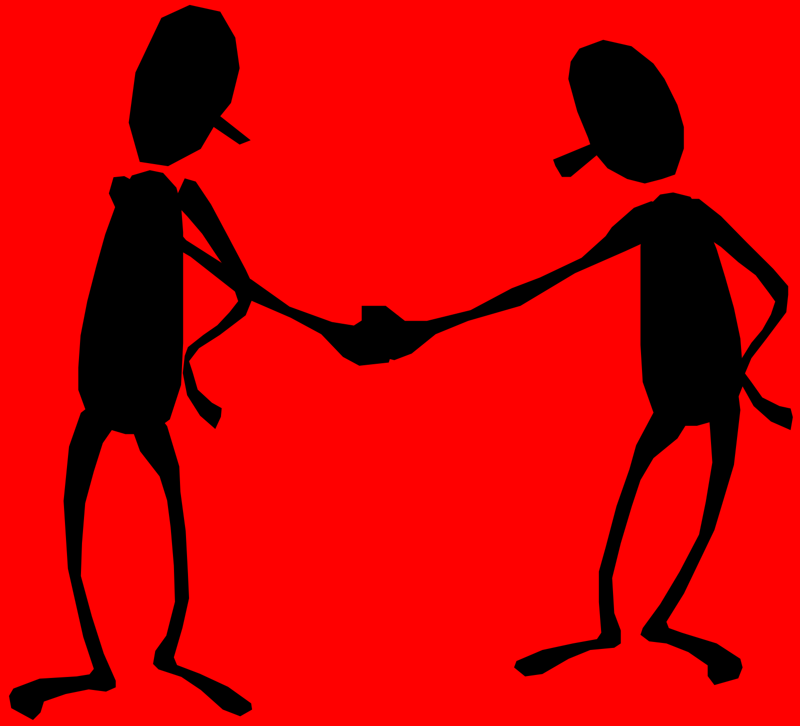
- **When the teacher praises the student's learning performance**

Negative

- **When the teacher criticizes the student's performance in a sarcastic or demeaning manor**

Courtesy

- Respect of and for another; politeness
- Use courteous words as frequently with low achievers as with other students and as frequently with all students as with adults



Positive

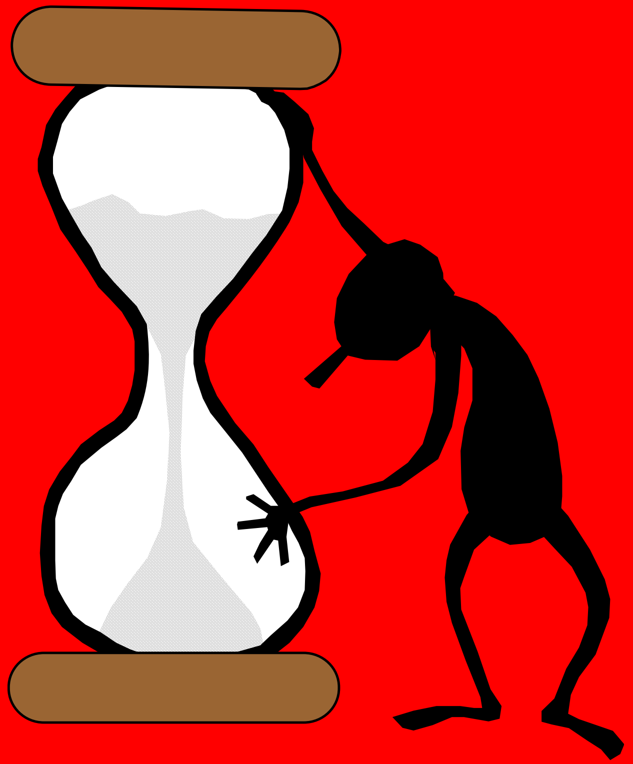
- **When the teacher uses expressions of courtesy in interaction with the student**

Negative

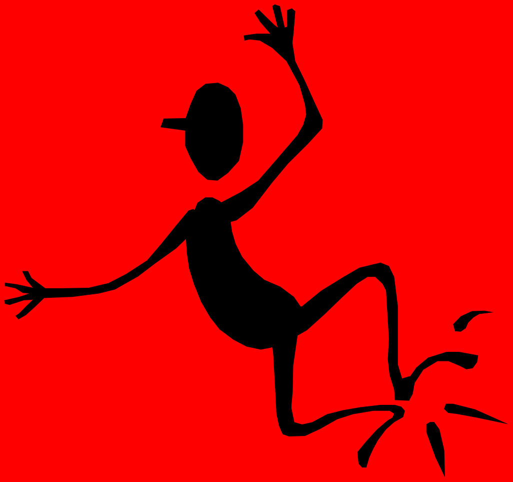
- **When the teacher behaves toward the student in a disrespectful manner that would not be characteristic of the teacher's behavior towards adults**

Latency (3)

- “Wait time”: the time that elapses between asking a question and terminating the response opportunity



Positive



- **When the teacher allows the student enough time to think the question over before the teacher terminates the response opportunity or attempts to assist the student**

Negative

- **When the teacher allows the student less than five seconds to respond**

Reasons for Praise

- According to Brophy(1986), students should be praised when they:
  - **have made genuine progress;**
  - **may not realize or appreciate their accomplishments;**
  - **respond well to praise**

Positive

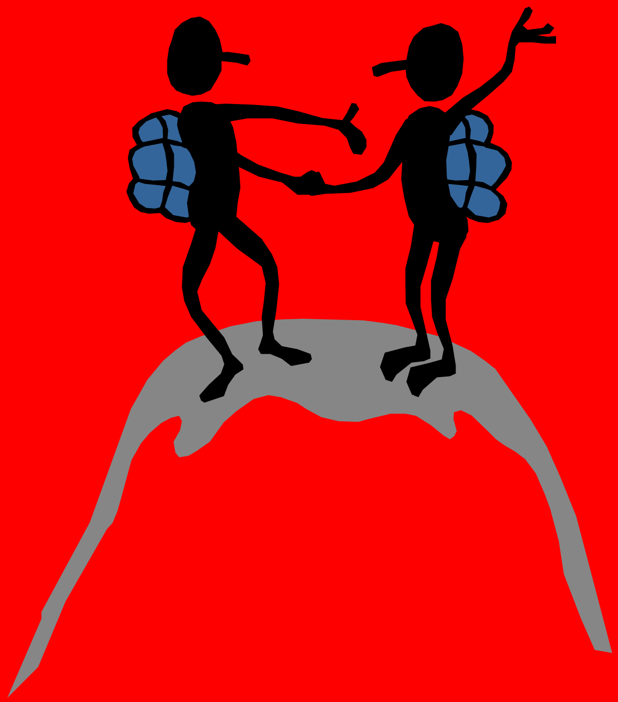
- **When the teacher gives a reason for praising a student’s learning performance**

Negative

- **When the teacher is sarcastic or gives insincere praise**

Personal Interest Statements and Compliments

- The teacher gives compliments or makes statements relating to a student's personal interests in recognition of students behaviors that are extraneous to the instructional tasks



Positive

- **When the teacher asks questions, compliments, or makes statements relating to the student's personal interests or experiences**

Negative

- **When the teacher negatively curtails or belittles the student's attempt to tell about a personal interest or activity**

Delving, Rephrasing, Giving Clues (4)

- To help all students to respond to questions by providing them additional information

Positive

- **When the teacher provides any additional information verbally or nonverbally to help the student respond to a question**

Negative

- **When the teacher terminates the response opportunity of a student who has not responded or whose answer was inadequate without rephrasing the question, providing additional information, or delving in some way**

Listening

- The Rule of Two-Thirds states that, in the average classroom, someone is talking 2/3 of the time. Two-thirds of that time, the person talking is usually the teacher.

Positive

- **When the teacher maintains eye contact with the student or indicates to the student that the response was heard**

Negative

- **When the teacher is inattentive to a student whose verbal communication has been invited or permitted**

Jule Scarborough< 2006, some content based upon J.Parker, 2001

Touching

- Touching is a form of communication (for example, a pat on the back to show approval or congratulations)

Positive

- **When the teacher touches the student in a friendly manner**

Negative

- **When the teacher rejects the student's attempt to touch the teacher or uses touch as punishment**

Higher-Level Questioning (5)

- To ask a question that stimulates a students cognitive reasoning skills
- Higher-level questioning strategies provide opportunities for all students to think

Jule Scarborough< 2006, some content based upon J.Parker, 2001

Positive

- **When the teacher asks the student a question that requires him/her to do something more than merely remember the answer from reading, previous teacher instruction, or another source**

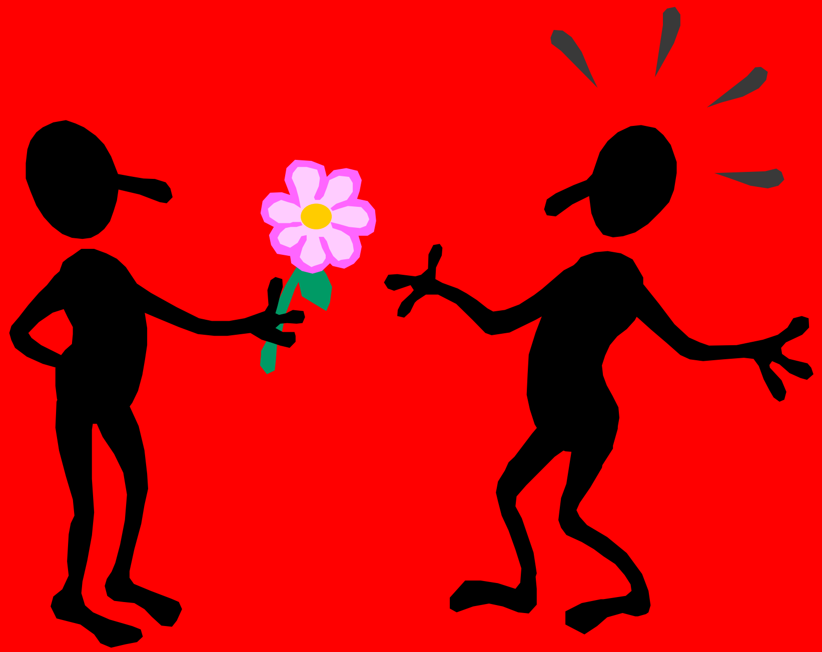
Negative

- **When the teacher implies or states that questions are either easy or difficult**

Jule Scarborough< 2006, some content based upon J.Parker, 2001

Accepting Feelings

- Receptive responses by a teacher showing that he/she recognizes the feelings underlying a particular behavior and acknowledges them



Positive

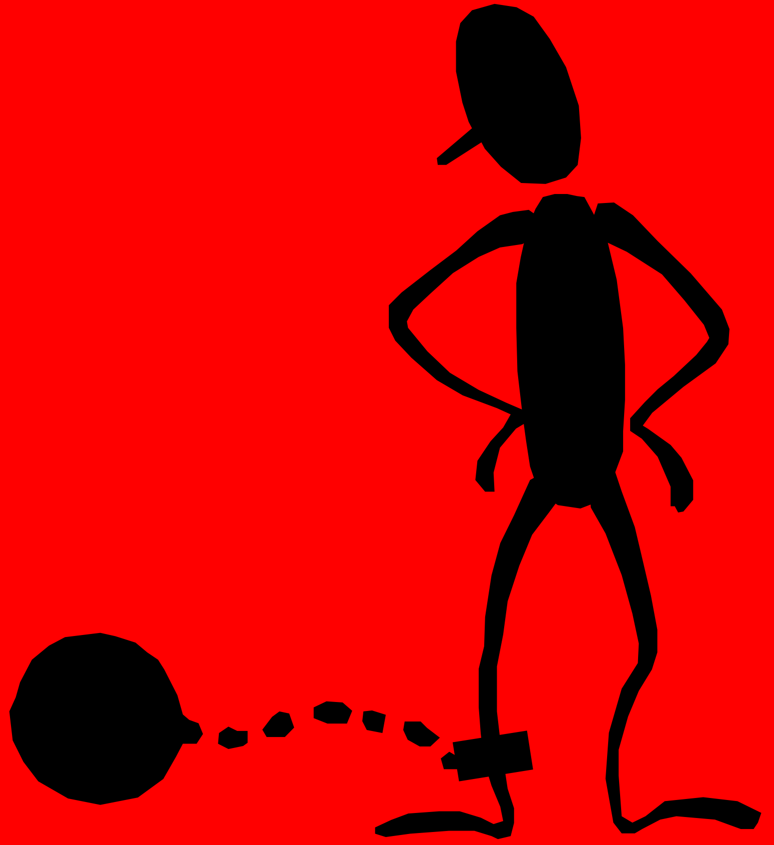
- **When the teacher recognizes and accepts a student’s feelings in a nonevaluative manner**

Negative

- **When the teacher discourages or disparages a student’s feelings**

Desisting

- “a teacher’s doing something to stop a misbehavior” : in other words, a disciplinary action by the teacher



Positive

- **When the teacher asks a student to desist from a behavior in a calm, courteous manner that does not put the student down and does not imply that misbehavior was expected of him/her**

Negative

- **When the teacher insults the student or vents anger and hostility on the student in dealing with misbehavior**

Teaching Standards

- Teaching standards for your discipline are in your packets
- Ask yourself the following questions:
  - Do I meet the standards of good teaching in my discipline?
  - What are my strengths and which areas do I need to develop?
- Meet as a discipline and discuss your answers
  - Collectively, what do your answers mean for your students?

Active Learning

Cooperation in the Classroom

David W. Johnson

Roger T. Johnson

Karl A. Smith

(Interaction Book Company, 1998)

This powerpoint presentation was taken directly from the text by Johnson, Johnson, and Smith, 1998

Jule Scarborough, 2006

(for PowerPoint presentations, contact julescarborough@niu.edu)

Causes of Missed Opportunities to Capitalize on the Power of Groups

1. Belief that isolated work is the natural order of the world.
2. Resistance to taking responsibility for others.
3. Confusion about what makes groups work.
4. Fear that they cannot use groups effectively to enhance learning and improve teaching.
5. Concern about time and effort required to change.

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Definitions

- Cooperation: We Sink or Swim Together

(Individuals work together to achieve shared goals; maximize own and others' learning)

- Competition: I Swim, You Sink; I Sink, You Swim

(Individuals work against each other to achieve a goal only one or a few can attain)

- Individualistic: We Are Each in this Alone

(Individuals work by themselves to achieve goals unrelated to others' goals)

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Figure 1.1 Circles Of Learning

Social Interdependence

Cooperative	Competitive	Individualistic

Research: Why Use Cooperative Learning

Effort To Achieve	Positive Relationships	Psychological Health

Five Basic Elements

Positive Interdependence	Individual Accountability	Promotive Interaction	Social Skills	Group Processing

Cooperative Learning

Formal Coop Learning	Informal Coop Learning	Coop Base Groups
Make Preinstructional Decisions	Conduct Introductory Focused Discussion	Opening Class Meeting To Check Homework, Ensure Members Understand Academic Material, Complete Routine Tasks Such As Attendance
Explain Task And Cooperative Structure	Conduct Intermittent Pair Discussions Every Ten Or Fifteen Minutes	Ending Class Meeting To Ensure Members Understand Academic Material, Homework Assignment
Monitor Learning Groups And Intervene To Improve Taskwork & Teamwork	Conduct Closure Focused Discussion	Members Help And Assist Each Other Learn In-Between Classes
Assess Student Learning And Process Group Effectiveness		Conduct Semester Or Year Long College Or Class Service Projects

Cooperative College

Teaching Teams	Site-Based Decision Making	Faculty Meetings

Constructive Conflict

Students		Faculty	
Academic Controversy	Negotiating, Mediating	Decision-Making Controversy	Negotiating, Mediating

Civic Values

Work For Mutual Benefit, Common Good	Equality Of All Members	Trusting, Caring Relationships	View Situations From All Perspectives	Unconditional Worth Of Self, Diverse Others

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Table 1.1: Comparison Of Old And New Paradigms Of Teaching

Factor	Old Paradigm Of Teaching	New Paradigm Of Teaching
Knowledge	Transferred From Faculty To Students	Jointly Constructed By Students And Faculty
Students	Passive Vessel To Be Filled By Faculty's Knowledge	Active Constructor, Discoverer, Transformer of Own Knowledge
Nature Of Learning	Learning Is Fundamentally Individual; Requires Extrinsic Motivation	Learning Is Fundamentally Social; Requires Supportive Environment/Community To Unleash Intrinsic Motivation
Faculty Purpose	Classify And Sort Students	Develop Students' Competencies And Talents
Relationships	Impersonal Relationships Among Students And Between Faculty And Students	Personal Transaction Among Students And Between Faculty And Students
Context	Competitive/Individualistic	Cooperative Learning In Classroom And Cooperative Teams Among Faculty
Assumption	Any Expert Can Teach	Teaching Is Complex And Requires Considerable Training

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The New Paradigm of Teaching

- Principal Activities...
  - Knowledge is <u>constructed</u>, <u>discovered</u>, <u>transformed</u>, and <u>extended</u> by students
  - Students <u>actively</u> <u>construct</u> their own knowledge
  - Learning is a <u>social</u> enterprise in which students need to interact with the instructor and classmates
  - Faculty effort is aimed at developing students' <u>competencies</u> and <u>talents</u>

The New Paradigm of Teaching

- Principal activities cont..
  - Education is a personal transaction among students and between the faculty and students as they work together
  - All of the above best take place within a cooperative context
  - Teaching is assumed to be a complex application of theory and research that requires considerable instructor training and continuous refinement of skills and procedures

Implementing The New Paradigm: Cooperative Learning

- Learning Together or Alone

  - Students’ learning goals may be structured to promote cooperative, competitive, or individualistic efforts

  - Instructional activities are aimed at accomplishing goals and are conducted under a goal structure.

Implementing The New Paradigm: Cooperative Learning

- Learning Goal (Outcome or Objective)

  - A desired future state of demonstrating competence or mastery in the subject area being studied

Implementing The New Paradigm: Cooperative Learning

- Goal Structure
  - Specifies the ways in which students will interact with each other and the instructor during the instructional session

Implementing The New Paradigm: Cooperative Learning

- **Cooperative Learning**
  - Instructional use of <u>small groups</u> so that students work together to <u>maximize</u> their own and each other's <u>learning</u>

Implementing The New Paradigm: Cooperative Learning

- **Competitive Learning**
  - Students work <u>against</u> each other to achieve an academic goal

- **Individualistic Learning**
  - Students work <u>by themselves</u> to accomplish learning goals unrelated to those other students

Implementing The New Paradigm: Cooperative Learning

- **Why Use Cooperative Learning?**
  - Greater **effort** to achieve by students
  - More **positive** relationships among students
  - Greater **psychological** health

Implementing The New Paradigm: Cooperative Learning

- **Types of Cooperative Learning Groups**
  - **Formal** cooperative learning
    - Multiple sessions
  - **Informal** cooperative learning
    - Ad-hoc
  - Cooperative **base groups**
    - Long-term (1yr+) (in my case – one semester)

Implementing The New Paradigm: Cooperative Learning

- Types of Cooperative Learning Groups

  - For each group there are cooperative learning scripts

    (once conducted several times, they become automatic)

  - Scripts are procedures for:
    - Conducting generic, repetitive lessons-writing reports or giving presentations, typical routines, etc.
    - Managing classroom routines, e.g. checking homework, test process or procedures, reviewing test, standard protocols

Implementing The New Paradigm: Cooperative Learning

- Types of Cooperative Learning Groups
  - When you use these groups repeatedly, you will gain a routine-level of experience.
  - Expertise is reflected in your proficiency, competence, and skill in doing something

Implementing The New Paradigm: Cooperative Learning

- Expertise in structuring cooperative efforts is reflected in your being able to:
  - Take any lesson in any subject area with any age student and structure it cooperatively
  - **Use cooperative learning 60 to 80 percent of the time**
  - Describe precisely what you are doing and why
  - Apply the principles of cooperation to other settings, such as professional relationships and staff meetings.

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Implementing The New Paradigm: Cooperative Learning

- **Expertise** can be achieved by:
  - Teaching a cooperative lesson
  - Assessing how well it went
  - Reflecting on how cooperation could have been better structured
  - Teaching an improved cooperative lesson
  - Reassessing lesson, repeat process

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Implementing The New Paradigm: Cooperative Learning

- **What Kind Of Group Am I Using?**
  - **Pseudo**-Learning Group
  - **Traditional** Classroom Learning Group
  - **Cooperative** Learning Group
  - **High Performance** Cooperative Learning Group

Implementing The New Paradigm: Cooperative Learning

- **Pseudo-Learning Group**
  - The <u>sum</u> of the <u>whole</u> is **<u>less</u>** than the potential of the individual members.
  - Students believe that they are **<u>rivals</u>** with each other and must be defeated.

Implementing The New Paradigm: Cooperative Learning

- **Traditional Classroom Learning Group**
  - The sum of the whole is **more** than the potential of **some** members.
  - Students put in teams where little or **no** "real" **teamwork** is required and believe they will be evaluated as individuals.

Implementing The New Paradigm: Cooperative Learning

- **Cooperative Learning Group**

  - **More than the sum of their parts;**

  - **<u>All</u> students perform higher academically than <u>alone</u>.**

  - Students **believe** and understand that their **<u>success</u> <u>depends</u>** on the **<u>efforts</u> <u>of</u> <u>all</u>** group members

Jule Scarborough, 2006

Implementing The New Paradigm: Cooperative Learning

- **High-Performance Cooperative Learning Group**
  - Cooperative learning group that **outperforms <u>all</u> <u>reasonable</u> <u>expectations</u>**, given its membership

Implementing The New Paradigm: Cooperative Learning

- What makes Cooperation Work
  - Take your existing lessons, curricula, and courses and <u>structure</u> them cooperatively
  - <u>Tailor</u> cooperative learning lessons to your unique instructional needs, circumstances, curricula, subject areas, and students
  - <u>Diagnose</u> the problems some students may have in working together and intervene to increase the effectiveness of the student learning groups

Implementing The New Paradigm: Cooperative Learning

- **What makes Cooperation Work**
  - 5 essential lesson elements:
    - Positive **interdependence**
    - Individual and group **accountability**
    - Promoting **interaction** between members
    - Teaching **interpersonal** and **small group** skills
    - **Group Processing**

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Implementing The New Paradigm: Cooperative Learning

- **Positive Interdependence**
  - Group members perceive they are **<u>linked</u> with each other** in which everyone succeeds together or not at all

Implementing The New Paradigm: Cooperative Learning

- **Individual and Group Accountability**
  - The performance of each **individual** student is assessed and used to ascertain who in the group needs more assistance, support, and encouragement.
  - Students **learn together** so that they can subsequently **perform higher as individuals**.

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Implementing The New Paradigm: Cooperative Learning

- **Promotive Interaction**
  - When members **share resources** and **help support**, encourage, and praise each other's efforts to learn

Implementing The New Paradigm: Cooperative Learning

- **Teaching Interpersonal and Small Group Skills**
  - In cooperative learning groups students are required to learn academic subject matter **(taskwork)** and also to learn the interpersonal and small group skills required to function as part of a group **(teamwork).**

Implementing The New Paradigm: Cooperative Learning

- **Group Processing**
  - Group members **discuss how well** they are **achieving** their **goals** and maintaining effective working **relationships**.

Understanding Cooperative Learning

Types Of Groups	Cooperative Groups	Essential Elements	Outcomes
Pseudo Groups	Formal Cooperative Learning	Positive Interdependence	Effort To Achieve
Traditional Groups	Informal Cooperative Learning	Individual Accountability	Positive Relationships
Cooperative Groups	Cooperative Base Groups	Promotive Interaction	Psychological Health
High-Performing Cooperative Groups		Interpersonal And Small Group Skills	
		Group Processing	

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Implementing The New Paradigm: Cooperative Learning

- **Managing Conflicts Constructively**
  - Students must be **taught** the **procedures** and **skills** to:
    - **Manage** the academic/intellectual conflicts inherent in learning groups
    - **Negotiate** constructive resolutions to their conflicts and mediate classmates' conflicts
      - Train students to negotiate
      - Train students to mediate

Table 1.2 Conflict Resolution Procedures

Academic Controversy	Peacemaker Program	
	Problem-Solving Negotiations	Peer Mediation
Research And Prepare Positions	State What You Want	End Hostilities
Present And Advocate Position	State How You Feel	Ensure Commitment To Mediation Process
Open Discussion: Advocate, Refute, Rebut	State Your Reasons For Wanting And Feeling As You Do	Facilitate Problem-Solving Negotiations
Reverse Perspectives: Present Opposing Position	Reverse Perspectives: Summarize Opposing Position	Formalize Contract
Reach Consensus On Best Reasoned Judgment: Synthesize	Create Three Optional Agreements That Maximize Joint Outcomes	
	Choose One And Formalize Agreement	

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Implementing The New Paradigm: Cooperative Learning

- The Cooperative College:
  - Uses cooperative learning the majority of the time in the classroom
  - Forms teaching teams, task forces, and ad hoc decision-making groups within a college
  - Implements administrative cooperative teams within the college

Gaining Expertise In Cooperative Learning

Year	Training And Application
One	Instructors (and administrators) are organized into teaching teams that meet weekly and are trained in the fundamentals of cooperative learning. The instructors become an inhouse demonstration project for other instructors to view and then emulate.
Two	Instructors are trained in the integrated use of (a) formal, informal, and base groups, (b) cooperative, competitive, and individualistic learning, as well as the teaching of advanced social skills. Administrators receive six days of training on the cooperative college.
Three	Instructors are trained in how to (a) create academic conflicts to intellectually challenge students, and (b) use a peer mediation program to manage classroom and college discipline problems. The "superstar" instructors receive leadership training on how to (a) conduct the training on cooperative learning, (b) give inclassroom help and support to the instructors being trained, and (c) organize teaching teams. The leaders are then given responsibility for conducting the training in their district.
Four	Continued functioning of colleagial support groups supported by the instructors trained to be leaders.

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Active Learning

Formal Cooperative Learning Chapter 2

David W. Johnson
Roger T. Johnson
Karl A. Smith

(Interaction Book Company, 1998)

This powerpoint presentation was taken directly from the text by Johnson, Johnson, and Smith, 1998

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Formal Cooperative Learning Groups

- Instructor's Role: Being "A Guide On The Side"
  - Make preinstructional decisions
  - Explain the task and cooperative structure
  - Monitor and intervene
  - Evaluate and process

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Formal Cooperative Learning Groups

- **Preinstrucional Decisions**

Choose academic objectives and social skills objectives:

Choose social skills by:

- Monitoring the learning groups
- Diagnosing the skills needed to solve problems students are having in working with each other
- Asking students to identify social skills that would improve their teamwork.
- Keeping a list of social skills you teach to every class.
- Analyzing what social skills are required to complete the assignment

Formal Cooperative Learning Groups

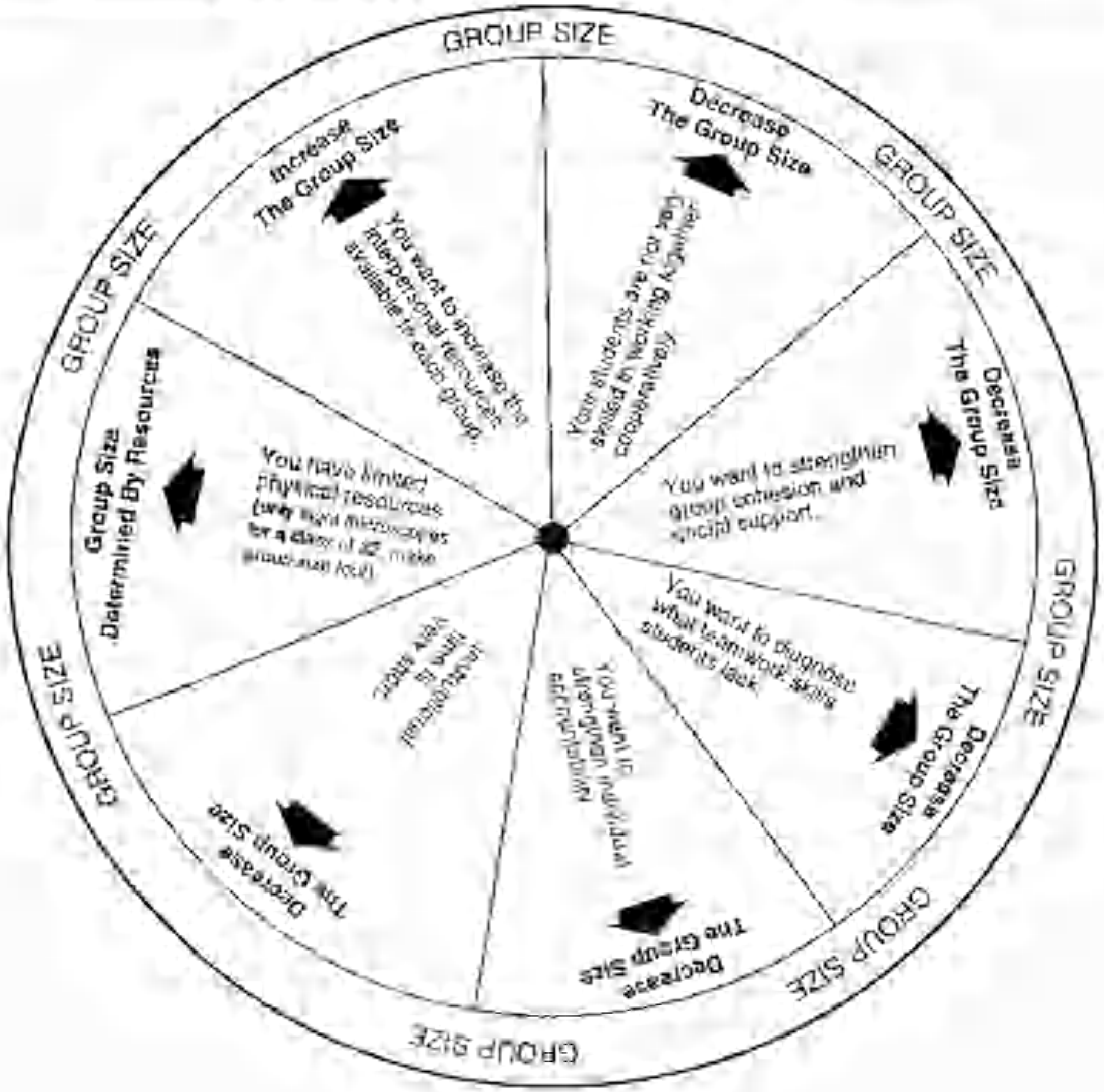
- **Deciding on the size of the group**

  - **The smaller the better:**
    - With the addition of each member, the resources to help the group succeed increase
    - The shorter the period of time available, the smaller the learning group should be
    - The smaller the group, the more difficult it is for students to hide

Formal Cooperative Learning Groups

- The larger the group, the more skillful group members must be
- The larger the group, the less the interaction among members
- The materials available or the specific nature of the task may dictate a group size
- The smaller the group, the easier it is to identify any difficulties students have in working together

THE GROUP SIZE WHEEL



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Formal Cooperative Learning Groups

- **Assigning students to groups**
  - **Advantages to heterogeneous groups**
    - Students are exposed to a variety of ideas, multiple perspectives, and different problem solving methods
    - Generate more cognitive <u>disequilibrium</u>
    - Engage in more elaborative thinking, give and receive more explanations, and engage in more frequent perspective-taking

Formal Cooperative Learning Groups

- **Methods of assigning students to groups**
  - Random assignment
  - Stratified random assignment-(note on tech KSAs)
  - Preferences
  - Instructor selected groups
  - Self-selected groups
  - Length of life groups
  - Combination

Formal Cooperative Learning Groups

- **Assigning roles to ensure interdependence**
  - Do not assign roles to let students get used to working together
  - Assign only simple roles to students
  - Add to the rotation a new role that is slightly more sophisticated, e.g. “checker for understanding”
  - Add formulating and fermenting roles that do not occur naturally in the group,e.g. “relater of K”

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Formal Cooperative Learning Groups

Solving-preventing problems in working together

- Reduce problems such as one or more members' making no contribution to the group or one member dominating the group

- Ensure that vital group skills are enacted in the group and that group members learn targeted skills

- Create role interdependence among group members by assigning members interconnected roles

Formal Cooperative Learning Groups

- **Arranging the room by:**
  - Using labels and signs to designate areas
  - Using colors to attract visual attention
  - Taping lines on the floor
  - Using mobiles and forms
  - Using lighting
  - Moving furniture

Formal Cooperative Learning Groups

- **Planning the instructional materials**
  - You create:
    - Materials interdependence
    - Information interdependence
    - Interdependence from outside enemies

EXPLAINING THE TASK: FLOW CHART

1. Explain the assignment. The assignment needs to be a clear, measurable task.
2. Explain lesson objectives to ensure transfer and retention. Objectives may be stated as outcomes--*"At the end of this lesson you will be able to explain the causes of the French and Indian War."*
3. Explain the concepts, principles, and strategies students need to use during the lesson and relate them to students' past experience and learning.
4. Explain the procedures students are to follow in completing the assignment.
5. Require a visible product that each student signs. This keeps students on task and helps ensure they will behave responsibly.
6. Ask class members specific questions to check their understanding of the assignment.
7. Ask students to answer in pairs or triads the questions the lesson will focus on to (a) establish expectations about what the lesson will cover and (b) organize in advance what they know about the topic.

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Structuring Task & Cooperative Structure

- **Explaining Criteria for Success**
  - Criterion-referenced or categorical judgments
    - Letter grades
    - Group improvement
    - Reaching a metric or standard

Structuring Task & Cooperative Structure

- **Structuring Positive Interdependence**
  - Positive goal interdependence
    - Structure “We”
    - Supplement with other interdependent elements, e.g. ”reward”
    - Peer encouragement results

Structuring Task & Cooperative Structure

- **Structuring Individual Accountability**
  - Make each group member a stronger individual in his/her own right by:
    - Assessing performance of each member
    - Giving the results back
    - Comparing to criteria
    - Providing direct Feedback

Structuring Task & Cooperative Structure

- **Structuring Intergroup Cooperation**
  - Encourage members to find groups :
    - Who are not finished and help them understand how to complete the assignment successfully
    - Who are finished and compare answers and strategies

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Structuring Task & Cooperative Structure

- **Specifying Desired Behaviors**

- When you use cooperative learning you must teach students the **small group** and **interpersonal skills** they need to work effectively with each other
    - You define the needed teamwork skills operationally by specifying the behaviors that are appropriate and **desirable** within learning groups
    - Be Specific, Start Small, Emphasize Over learning

The Cooperative Lesson

- **Cooperative Procedures**
  - Checking homework
  - Engaging in discussions
  - Taking notes
  - Reading assigned material
  - Drilling and reviewing
  - Writing compositions
  - Resolving intellectual conflicts
  - Executing projects

The Cooperative Lesson

- **Checking Homework**
  - **Task:** Students bring completed home work and understand how to do it correctly
  - **Cooperative:** Students meet in base group to ensure everyone understands how to complete the assignment correctly

The Cooperative Lesson

- **Checking Homework cont..**
  - **Procedure**
    - Students meet in groups
    - One member acquires materials from instructor
    - Group reviews assignment and concentrates on clarifying parts members did not understand—

      using roles such as “explainer” and “accuracy checker”
    - Record groups’ progress on assignment
    - Returns assignment to instructor

The Cooperative Lesson

- **Checking Homework cont..**
  - **Expected criteria for success**:

    All group members understand how to complete each part of the assignment correctly

    - **Individual Accountability**:

      Regular examinations and daily randomly selecting group members to explain how to solve randomly selected problems

The Cooperative Lesson

- **Turn To Your Neighbor Summaries**
  - **Task:** Students explain their answers and reasoning to a classmate
  - **Cooperative:** create a joint answer both agree on

The Cooperative Lesson

- **Turn To You Neighbor Summaries cont..**
  - **Procedure:**
    - Students formulate answer to a question
    - Students share answer with a neighbor
    - Listen to partner's explanation
    - Partners create new answer based on the additional information

Formulate, Share, Listen, Create

The Cooperative Lesson

- **Read And Explain Pairs**
- **Task:** Learn the material being read by establishing the meaning of each paragraph and integrating that meaning
    - **Cooperative:** Both members agree and explain meaning of material jointly

The Cooperative Lesson

- **Read And Explain Pairs**
  - **Procedure:**
    - Overview material
    - Student A summarizes
    - Student B checks accuracy
    - Reverse roles
    - Summarize and agree on meaning of material

The Cooperative Lesson

- **Read And Explain Pairs**
  - **Expected criterion for success:** Both members are able to explain the meaning of the material correctly.
  - **Instructors should systematically:**
    - Monitor each pair
    - Ensure individual accountability
    - Remind students about intergroup cooperation

The Cooperative Lesson

- **Reading Comprehension Triads**
  - **Task:**
    - Read material
    - Answer questions
    - Practice checking skills

The Cooperative Lesson

- **Reading Comprehension Triads**
  - **Cooperative:**
    - One set of answers from group, everyone agrees, everyone can explain each answer
    - +90%, each member receives bonus
    - Each member assigned a role

The Cooperative Lesson

- **Reading Comprehension Triads**
  - **Expected criteria for success:**

  Everyone must be able to answer each question correctly

The Cooperative Lesson

- **Reading Comprehension Triads**
  - **Individual Accountability**
    - One member randomly chosen to explain group's answer
    - Individual testing
    - Each member required to explain group's answers to another group

The Cooperative Lesson

- **Reading Comprehension Triads**
  - **Expected behaviors:** Active participation, checking, encouraging, and elaboration by all members
  - **Intergroup cooperation:** Check procedures, answers, and strategies with another group

The Cooperative Lesson

- **Reading Comprehension Triads**
- **Also known as:**
  - Cooperative Writing and Editing Pairs
  - Cooperative Note-Taking Pairs

The Cooperative Lesson

- **Jigsaw Procedure**
  - **Task:** Students to learn all assigned material
  - **Cooperative Goal:** Each member to ensure that everyone in group has learned material

The Cooperative Lesson

- **Jigsaw Procedure**
  - Cooperative Groups: Distribute unique material to each member in group
  - Preparation Pairs: Match pairs with identical members from other groups (i.e., part 1 group 1 with part 1 group 2)
    - Achieve expertness on material
    - Plan how to teach material to other groups

The Cooperative Lesson

- **Jigsaw Procedure**
  - **Practice Pairs:** Students pair with a new member with same part, practice teaching material
  - **Cooperative Groups:** Teach expertise to the other group members and learn material being taught. All parts of the material must be mastered

The Cooperative Lesson

- **Jigsaw Procedure**
  - **Monitoring:** Instructors assist students with procedures
  - **Evaluation:** Assess degree of mastery of all material with objective test taken individually. +90% receive bonus

The Cooperative Lesson

- **Drill-Review Pairs**
  - **Task:** Correctly solve problems or engage in procedures
  - **Cooperative:** Ensure both pair members understand the strategies and procedures to solve the problems correctly

The Cooperative Lesson

- **Drill-Review Pairs**
  - Individual Accountability: Instructor randomly chooses one member to explain how to solve a randomly selected problem

The Cooperative Lesson

- **Drill-Review Pairs**
  - **Procedure**
    - Person A explains the procedures and strategies required to solve problem
    - Person B checks accuracy of solution and provides encouragement and coaching
    - A and B reverse roles
    - Each pair compare solutions with other pairs
    - Procedure continues until all problems are completed

The Cooperative Lesson

- **Academic Controversies**
  - General format to structure Controversy
    - Topic with pro and con positions
    - Groups of 4, pro/con topic each pair
    - Assign each pair tasks:
      - Learn its position
      - Research
      - Prepare argument
      - Give presentation

The Cooperative Lesson

- **Joint Project**
  - Task: Complete project
  - Cooperative: create project groups, assign roles
  - Criteria for success: A completed project that each group member can explain

- **Consider Performance Tasks and Rubrics**

The Cooperative Lesson

- **Joint Project**
  - **Individual Accountability**
    - Each group member responsible for proving involvement
    - Each member presents project to another member or performs
    - Students individually tested or performance scored using rubric

The Cooperative Lesson

- **Joint Skills**
  - **Expected Social Skills:** Presenting ideas, eliciting ideas, and organizing work
  - **Intergroup Cooperation:** Check procedures, information, and progress with other groups

Monitoring And Intervening

- **Monitoring Students' Behavior**
  - **Four stages**
    - Preparing for Observing
    - Observing
    - Intervening when necessary
    - Students assess quality of their own participation
- **Use Rubrics**

Monitoring And Intervening

- **Guidelines**
  - Plan observing route through classroom
  - Use formal observation sheet - rubric
  - Do not obsess over behavior
  - Detail notes with specific student actions
  - Train and use student observers - rubric
  - Allocate time to discuss with observers

Monitoring And Intervening

- **Providing Task Assistance**
  - Cooperative learning groups provide instructors with a “window” into students’ minds

- Intervening to Teach Social Skills
  - Cooperative learning groups provide instructors with a picture of students’ social skills

Evaluating Learning and Processing Interaction

- Provide Closure to the Lesson
- Assess the Quality and Quantity of Learning
- Process How Well the Group Functioned
  - Feed back
  - Reflection
  - Improvement Goals
  - Celebration

Active Learning

Informal Cooperative Learning Chapter 3

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(Interaction Book Company, 1998)
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The Lure of Lecturing

- The extended presentation in which the instructor presents factual information in an organized and logically sequential way

The Lure of Lecturing

- **Reasons for use:**
  - Efficient
  - Flexible
  - Simple to implement
  - Makes instructor center of communication and attention

Lure of Lecture

- **Appropriate use of Lecturing**
  - Disseminate information
  - Present Material that is **not available** elsewhere
  - Expose students in a brief time **to content integrated from a variety of sources**
  - Expose students in a brief time to **content too complex for students to understand and learn on their own**

Lure of Lecture

– Demonstrate/model strategies and procedures students are to use in future assignments
– Expose students in a brief time to several different points of view
– Arouse students' interest in the subject
– Teach students who are primarily auditory learners

Lure of Lecture

- **Parts of a Lecture**
  - **Introduction**
    - Arouse interest
    - Motivational cues
    - Make objectives clear
    - Prompt awareness of relative knowledge
    - Use advance organizers
      - Concepts given to the student prior to the material actually to be learned that provide a stable cognitive structure in which the new knowledge can be subsumed

Lure or Lecture

- Parts of a Lecture
  - – **Body**
    - Cover content while providing a logical organization for the material being presented
  - – **Conclude**
    - Summarize major points, recall ideas, give examples, and answer questions

Lure of Lecturing

- **Problems With Lecture**
  - **Attention** to what the instructor is saying **decreases** as the lecture proceeds
  - Lecture takes an <u>educated</u>, <u>intelligent</u> person orientated toward <u>auditory</u> <u>learning</u> to <u>benefit</u>
  - Tends to only promote lower level learning

Lure of Lecture

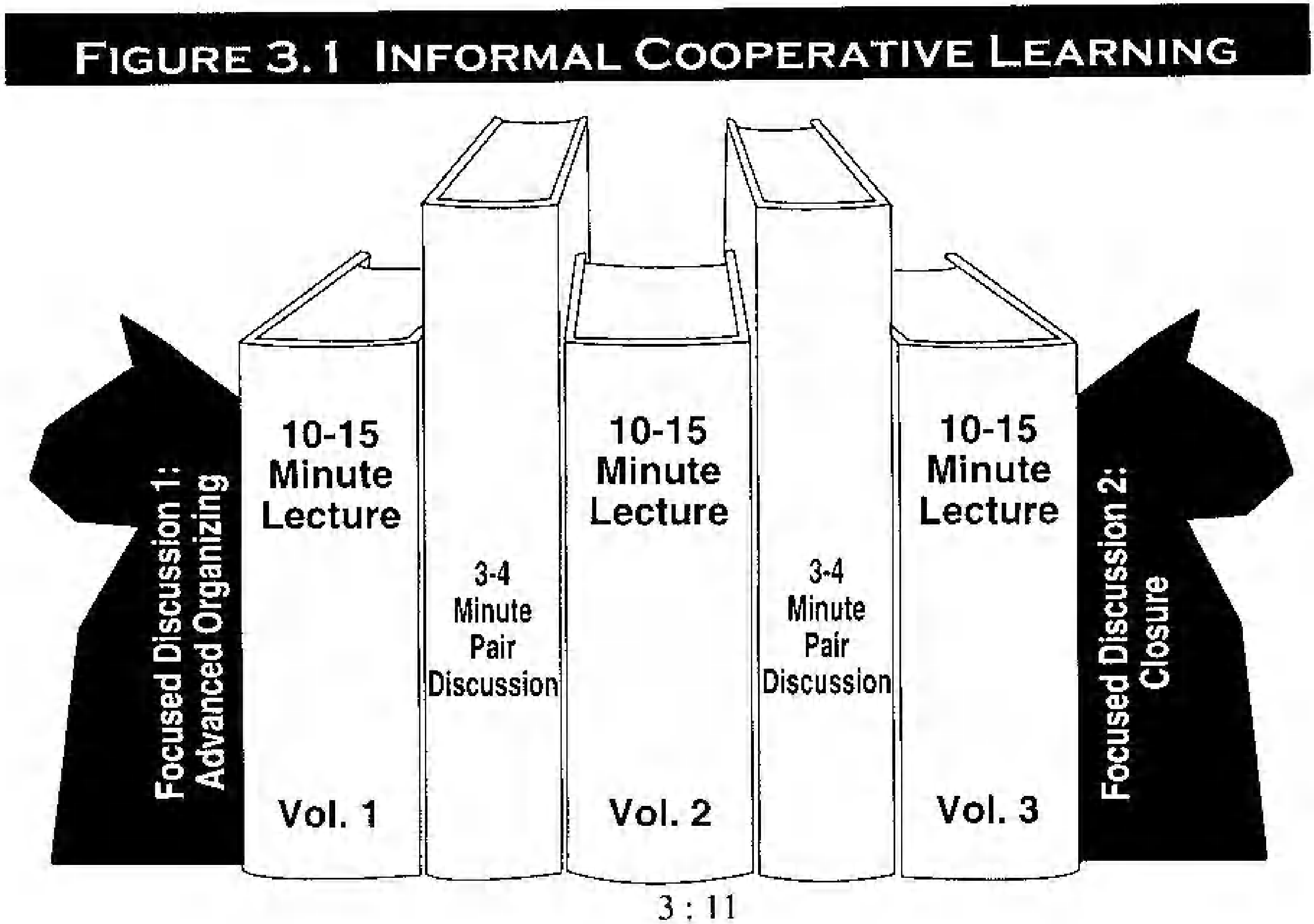
- **Problems With Lecture cont..**
  - Limited by assumption that all students need oral information at the same time and pace without dialogue
  - Students tend not to like it
  - Based on assumptions about students cognitive ability

Lure of Lecture

- **Enemies of the lecture**
  - Preoccupation
  - Emotional moods
  - Disinterest
  - Failure to understand
  - Feeling of isolation and alienation
  - Entertaining lecture that misrepresent importance of material

Informal Cooperative Learning Groups

- **Purpose**
  - To focus student attention on the material to be learned
  - Set a mood conductive to learning
  - Help organize in advance the material being taught
  - Provide closure to an instructional session



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Lecturing With Informal Cooperative Learning Groups

- **Introductory Focused Discussion**
  - Promote advance organization
  - Establishing expectations of lecture

Lecturing With Informal Cooperative Learning Groups

- **Intermittent Focused Discussions**
  - **Lecture Segment One**
    - 10 to 15 minute lecture
  - **Pair discussion 1**
    - Each student formulates answer
    - Students share answer with partner
    - Students listen to partner's answer
    - Pairs create new answer

Lecturing With Informal Cooperative Learning Groups

- **Intermittent Focused Discussions**
  - Repeat steps for additional segments and pair discussions until lecture is completed

- **Closure Focused Discussion**
  - Students complete an ending discussion task

Step One: Introductory Focused Discussion

- **Introductory Focused Discussion Pairs**
  - **Task:** Answer questions
  - **Cooperative:**
    - Formulate
    - Share
    - Listen
    - Create

Step One:
Introductory Focused Discussion

- **Introductory Focused Discussion Pairs**
  - **Expected Criteria For Success:** Each student able to explain answers
  - **Individual Accountability:** Random quizzing of individual students
  - **Expected Behaviors:** Explaining, Listening, synthesizing by all members
  - **Intergroup Cooperation:** Compare with another group

Step One:
Introductory Focused Discussion

- **Question-And-Answer Pairs**
  - **Task:** Answer questions on homework
  - **Cooperative:**
    - Students prepare for discussion
    - Students randomly assigned to pairs
    - Q&A session between pairs
    - Instructor provides feedback

Step One:
Introductory Focused Discussion

- **Question-And-Answer Pairs**
  - **Expected Criteria For Success:** Each student writes a paper and edits group members papers
  - **Individual Accountability:** Each student formulates question on assignment, partner answers questions
  - **Expected Behaviors:** Exchange questions, giving good explanations

Step One:

Introductory Focused Discussion

- **Advanced Preparation Papers**
  - **Task:** Write short paper
    - Choose topic relating to assigned reading
      - Major theory
      - Concept
      - Research study
    - Write analysis summarizing material and adding material from another source

Step One:
Introductory Focused Discussion

- **Advanced Preparation Papers**
  - **Cooperative:** Students will check each others papers in learning pairs, checking for:
    - Paper structure
    - Summary of theory
    - Clear conceptual definition of concepts and terms
    - New information beyond the text

Step One:

Introductory Focused Discussion

- **Advanced Preparation Papers**
  - Expected Criteria for success
    - Each student writes a paper and edits groupmates' papers
  - Individual Accountability
    - Each student writes a paper
    - Each student edits and signs another paper
    - Have students explain paper to another group

Step One:
Introductory Focused Discussion

- **Advanced Preparation Papers**
  - Expected behaviors: critically evaluating the papers of groupmates
  - Intergroup Cooperation: Check editing procedures and strategies with another group.

Progress Checks

- Progress Check: Consists of questions testing students' knowledge of the assigned reading
  - **Students:**
    - Individually complete the progress check
    - Retake the progress check and compare answers with group
    - Retake with the whole base group to broaden discussion

Step Two:
Intermittent Discussion Pairs

- **Intermittent Discussion Pairs**
  - Students form pairs and are given a short discussion task to be completed in 3 to 4 minutes to ensure that students actively cognitively process the information presented
    - Answer a question posed by the instructor
    - Give a reaction to the theory, concepts, or information being presented
    - Elaborate on the material being presented

Step Two: Intermittent Discussion Pairs

- Using intermittent discussion pairs can solve a number of problems inherent to lecturing…
  - Ensures that all students are actively involved in learning the material being presented in class

Step Two: Intermittent Discussion Pairs

- Active involvement solves three problems with class discussions:
  - – Lack of response by most students
  - – Domination by a few students
  - – Refusal to ask question

Step Two: Intermittent Discussion Pairs

- The use of intermittent discussion pairs facilitates the understanding and retention of material being learned
- Memory interference
  - Retroactive interference
    - Information at end of lecture interferes with information from beginning
  - Proactive interference
    - Information at beginning of lecture interferes with information from end.

Step Two: Intermittent Discussion Pairs

- The use of intermittent discussion pairs provides students with the opportunity to receive from classmates frequent and immediate feedback
  - Learning tools
    - Turn to your neighbor summaries
    - Cooperative note-taking pairs
    - Read and explain pairs

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Step Three: Closure Focused Discussions

- **Closure focused discussions:**
  - – Assign students to pairs or triads
  - – Give them an ending discussion task lasting 4 to 5 minutes
    - Learning tools
      - – Closure note-taking pairs
      - – Closure focused discussion pairs
      - – Closure cooperative writing pairs
      - – Closure review pairs
      - – Etc.

Other Informal Cooperative Learning Groups

- **Peer Feedback Groups**
  - Students tend to like courses that offer frequent opportunities to revise and improve their work.
  - Student learn best when they:
    - Have a chance to submit earlier version of their work
    - Get detailed feedback and criticism

Other Informal Cooperative Learning Groups

- **Peer Feedback Groups**
  - Walberg (1984) identified feedback as the most powerful predictor of learning
  - Students need continuous feedback about the adequacy of their performances which may be best provided by classmates

Other Informal Cooperative Learning Groups

- **Cooperative Study Groups**
  - The Harvard Assessment Seminars (Light, 1990) compared the grades of students who studied alone with those of students who studied in groups of four to six.
  - **Student in small groups performed better than students who worked alone**
  - Small groups:
    - **Spoke more often**
    - **Asked more questions**
    - **More engaged than larger groups**

Active Learning

Cooperative Base Groups

Chapter 4

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Class Base Groups

- The larger the class and the more complex the subject matter, the more important it is to have class base groups.
- The base groups meet at the beginning and ending of each class session or at the beginning of the first class session each week and at the end of the last class session each week.

Class Base Groups

- The members of base groups should information such as phone numbers and schedule information as they may wish to meet outside of class.

Class Base Groups

- All members are expected to contribute actively to the group’s work:
  - Maintain effective working relationships with other members
  - Complete all assignments
  - Assist group mates in completing their assignments
  - Indicate agreement with base group's work by signing weekly contract.

Class Base Groups

- At the beginning of each session students meet in base groups to:

1. Greet each other – check to see that no member is under undue stress.
2. Complete the next task for the membership grid. – helps members get to know each other.
3. Pick up their file folders with an attendance sheet, feedback form, and their assignments from the previous class session.

Class Base Groups

4. Check to see if members have completed homework or need help doing so

5. In addition to homework, members review what each member has read and done since the last class session.

   Each member may be prepared to:

   -give a summary of what he/she has read, thought about, done

   -share resources

   -share copies of completed assignments

Class Base Groups

6. Students collect each members' homework, record it in their Base Group Progress Report Sheet, and place the assignments in their file folder.

   - The file folder is returned to the instructors desk.
   - Periodically the base groups may be given a checklist of academic skills and assesses which ones each member needs to practice.

Class Base Groups

- Generally, class base groups are available to support individual group members.
- If a group member arrives late, or must leave early on an occasion, the group can provide information about what that student missed.
- Group members may assist one another in writing require papers and completing other assignments.

Class Base Groups

- The class session closes with students meeting in base groups. Closing tasks may be:
  - Ensure all students understand the assignments
  - Summarize at least three things members learned in today’s session.
  - Summarize how members will use/’apply what they have learned.
  - Celebrate the hard work and learning of group members.

Quick Base Group Meetings

- At times there may be only a few minutes for base groups to meet. Even in as short a time as five to ten minutes, base groups are given four tasks.

1. A quick self-disclosure task such as: *“What is the most exciting thing you did during your vacation break?”*

Quick Base Group Meetings

2. An administrative task such as what classes to register for next semester.

3. An academic task such as , *"You have midterms coming up. As a group, write out three pieces of advice for taking tests. I will type up the suggestions from each group and hand them out next week."*
4. A closing task such as wishing each other good luck for the day or week.

Building A Group Identity

- The effectiveness of base groups depends in part on the strength of the group identity.
- The first week the base groups meet, for example, base groups can:
  - Pick a name
  - Design a flag
  - Choose a motto

Building A Group Identity

- If an instructor with the proper expertise is available, the groups will benefit from participating in a “challenge course” involving ropes and obstacles.
- This type of physical challenge that the groups complete together builds cohesion quickly.

Base Group Grid

- The more personal the relationship among base group members, the greater the social support members can give each other.

- While students will get to know each other on a personal level while they work together, the process can be accelerated through the use of te base group grid.

Base Group Grid

Members	Topic1	Topic 2	Topic 3	Topic 4
Frank				
Helen				
Roger				
David				

Checking and Recording Homework

1. Homework is usually checked in base groups at the beginning of the class session

2. One member of each group, the runner, goes to the instructor's desk, picks up the group's folder, and hands out any materials in the folder to the appropriate members.

Checking and Recording Homework

1. The group reviews the assignment step-by-step to determine how much of the assignment each member completed and how well each member understands how to complete the material covered.

- Two roles are utilized:
  - **Explainer**
  - **Accuracy checker**

Checking and Recording Homework

- **Explainer** - explains step-by-step how to complete the material covered.

- **Accuracy Checker** - verifies that the explanation is accurate and provides coaching if needed.

Checking and Recording Homework

4. At the end of the review the runner records how much of the assignment each member completed, places members' homework in the group's folder, and returns the folder to the instructor's desk.

Base Group Contract Forms

- At the end of each class session the base group summarizes:
  - What they learned
  - How they will apply what they have learned
  - How they will help each other implement what was learned

Base Group Folders

- Provides direct communication between students and instructor
- Means for managing attendance, assignments, and feedback.
- In each folder is an **attendance sheet** that each member initials to indicate attendance at the session

Base Group Folders

- At the end of each session students place their completed **feedback form** in the folder.

- The feedback form may ask for
  - Three most important things learned
  - Favorite part of the session
  - Questions students may have

Value of Base Groups

- There are many reasons why cooperative base groups should be used.
  - Increase student achievement
  - Build more positive relationships among students
  - Increase students' psychological health

Value of Base Groups

- Base groups may also be used to:

  - Increase social support
  - Reduce attrition
  - Promote positive attitudes toward education

Nature of Social Support

- **Social Support** – the existence and availability of people whom one can rely for emotional, instrumental, informational, and appraisal aid.

- **Social Support System**- significant others who share a person's tasks and goals and provide resources that enhance the individual's well-being and help the individual mobilize his/her resources to deal with challenging and stressful situations.(Johnson&Johnson, 1989)

Nature of Social Support

- There are two types of social support:

1. Academic – classmates and faculty provide the assistance and help students need to succeed academically

2. Personal - classmates and faculty care about and are personally committed to the well-being of each student.

Base Groups and Social Support

- *The more social support a student has, the higher the student's achievement will tend to be, the more the student will persist on challenging tasks, the more likely students will be graduated , the healthier psychologically and physically the students will tend to be, the better able the students will be to manage stress, and the more likely students will be to challenge their competencies to grow and develop. (Johnson $ Johnson,1989)*

THE POWER OF COOPERATIVE BASE GROUPS

RESOURCES	FUNCTIONS: TO INCREASE
1. **Emotional concern** such as attachment, reassurance, and a sense of being able to rely on and confide in a person, all of which contribute to the belief that one is loved and valued.	1. **Achievement and productivity**, including persistence on difficult and challenging tasks.
2. **Instrumental aid** such as direct aid, goods, or services.	2. **Physical health** as individuals involved in close relationships live longer, get sick less often, and recover from illness faster than do isolated individuals.
3. **Information aid** such as facts or advice that may help to solve a problem.	3. **Psychological health**, as close relationships promote adjustment and development by preventing neuroticism and psychopathology, reducing distress, and providing resources such as confidants.
4. **Appraisal aid** such as feedback about degree to which certain behavioral standards are met (information relevant to self-evaluation).	4. **Constructive management of stress and challenges** by providing the caring, resources, information, and feedback needed to cope with stress and by buffering the impact of stress on the individual. Social support and stress are related in that the greater the social support individuals have, the less the stress they experience, and the better able they are to manage the stresses involved in life. The same is true of challenges that test the limits of a student's ability and resolve. There are few challenges that cannot be met when sufficient social support is provided.

Long-Term Cooperative Efforts

- The longer a cooperative group exists, the more caring their relationships will tend to be, the greater the social support they will provide for each other, the more committed they will be to teach other's success, and the more influence members will have over each other.

SOCIAL SUPPORT

ACADEMIC SUPPORT	PERSONAL SUPPORT
Encourage And Hold Members Accountable To Complete Assignments, Attend Class, And Achieve Academically	Personalize Class And [illegible] Life
Discusses Assignments, Answers Questions, Give Help & Assistance In Understanding Material Being Studied	Listen Sympathetically When A Member Has Problems With Friends Or Parents
Provides Information About What a Late Or Absent Member Missed	Help Each Other Solve Nonacademic Problems
Prepares Members To Take Tests And Go Over Questions Missed Afterwards	Communicate Respect, Liking, And Confidence In One's Ability To Manage One's Challenges
Share Areas Of Expertise (Such As Art Or Computers) With Each Other	Communicate Commitment To One's Well-Being
Monitor Members' Academic Progress And Ensure They Are Achieving	Discuss Personal Beliefs And Experiences

Attrition

- Two of the causes of dropping out of school are social alienation and academic alienation.
- Any student who believes that *"in this school, no one knows me, no one cares about me, no one would miss me when I'm gone,"* is at the risk of dropping out.

Attrition

- **Base groups also provide a means of fighting a student’s inclination to drop out.**

Changing Students' Attitudes About Academic Work

- There are several general principles, supported by research (see Johnson & F. Johnson, 1997) to guide faculty efforts.

1. Attitudes are changed in groups, not individual by individual.
2. Attitudes are changed as a result of small group discussions that lead to public commitment to work harder in school and take education more seriously.

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Changing Students' Attitudes About Academic Work

3. Messages from individuals who care about, and are committed to, the students are taken more seriously than messages from indifferent others.

4. Personally tailor appeals to value education to the student. General messages are not nearly as effective as personal messages.

Changing Students' Attitudes About Academic Work

5. Plan for the long term, not sudden conversions. Internationalization of academic values will take years of persuasion by caring and committed peers

6. Support from caring and committed peers is essential to modifying attitudes and behaviors and maintaining the new attitudes and behaviors.

Meaning, Purpose, and Psychological Health

- **Meaning** – is primarily created from contributing to the well being of others and the common good.

- The significance of one's actions depend on the degree to which one balances concern for self with concern for others and the community as a whole.

Meaning, Purpose, and Psychological Health

- Young adults have turned away from careers of public service to careers of self-service.
- Many young adults have a **delusion of individualism** believing that:
  - A. they are separate and apart from other individuals and therefore,
  - B. others' frustration, unhappiness, hunger, despair and misery have no significant bearing on their own well-being

Conclusions

- **Base Groups** – are long-term heterogeneous cooperative leaning groups with stable membership whose primary responsibilities are to provide support, encouragement, and assistance in completing assignments and hold each other accountable for striving to learn.

Active Learning

Five Basic Elements

Chapter Five

David W. Johnson
Roger T. Johnson
Karl A. Smith

(Interaction Book Company, 1998)
This powerpoint presentation was taken directly from the text by Johnson, Johnson, and Smith, 1998
Jule Scarborough, 2006

(for PowerPoint presentations, contact julescarborough@niu.edu)

Types Of Groups

Demonstrate your understanding of the different types of groups by matching the definitions with the appropriate group. Check your answers with your partner and explain why you believe your answers to be correct.

Type Of Group		Definition
	Pseudo Group	a. A group in which students work together to accomplish shared goals. Students perceive they can reach their learning goals if and only if the other group members also reach their goals.
	Traditional Learning Group	b. A group whose members have been assigned to work together but they have no interest in doing so. The structure promotes competition at close quarters.
	Cooperative Learning Group	d. A group that meets all the criteria for being a cooperative group and outperforms all reasonable expectations, given its membership.
	High- Performance Cooperative Learning Group	c. A group whose members agree to work together, but see little benefit from doing so. The structure promotes individualistic work with talking.

Basic Elements of Cooperative Learning

Pseudo-Learning Group

- Members assigned to work together but have no interest in doing do.

- **Members often will:**
  - Block or interfere with each other
  - Communicate and coordinate poorly
  - Mislead or confuse each other
  - Not participate and seek free ride

The sum of the whole is less than the potential of the individual members

Basic Elements of Cooperative Learning

<u>Traditional</u> Classroom Learning Group

- Members accepted that they are to work together, but see little benefit from doing so.
- **Member’s:**
  - Only take responsibility for themselves
  - Interact primarily to share information
  - Each do work on their own
  - Accountable as individuals not as team

Basic Elements of Cooperative Learning

Cooperative Learning Group

- A group whose members are committed to the common purpose of maximizing each other's learning

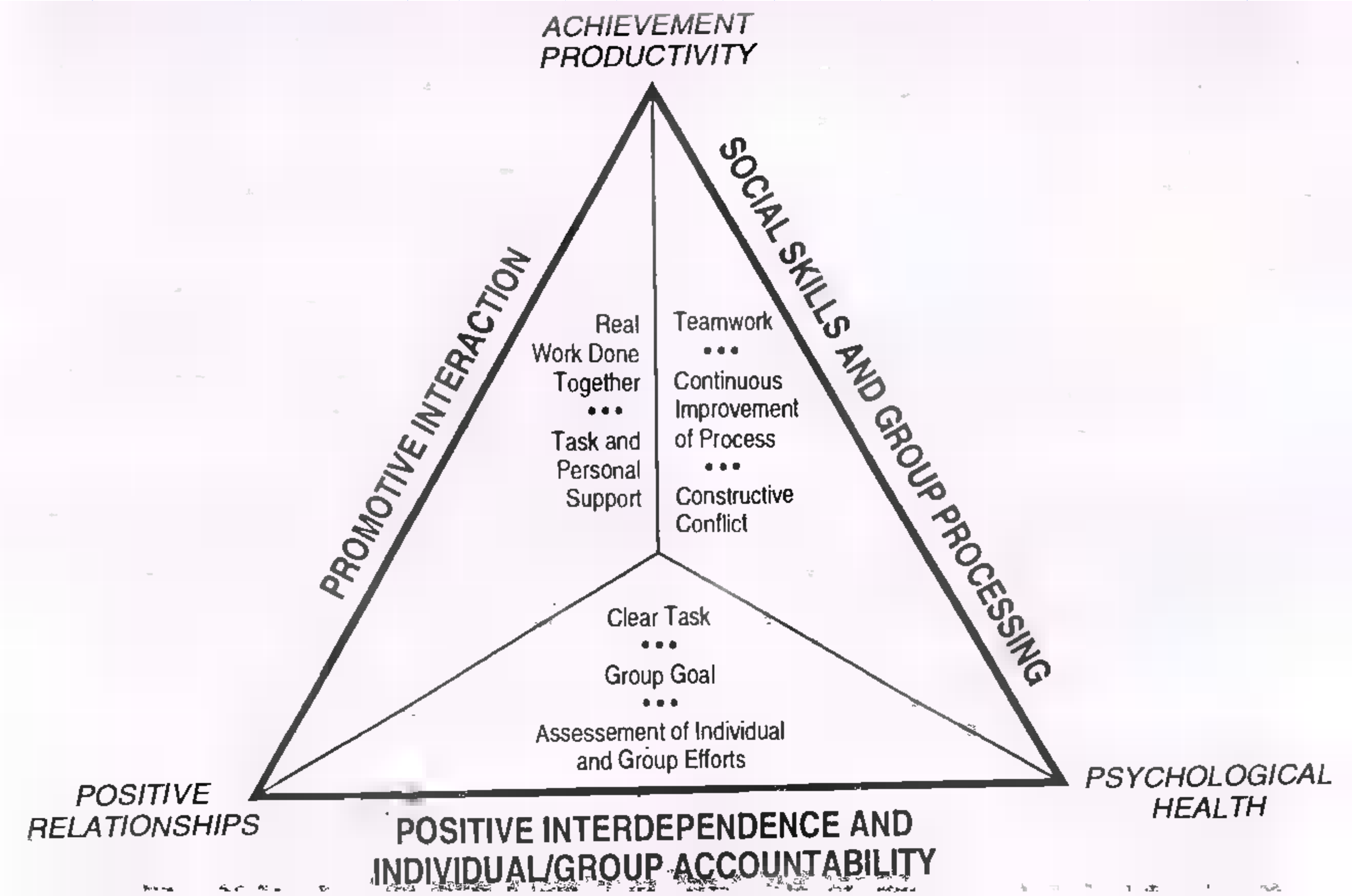
- **Characteristics**
  - **Maximizing all members' learning**
  - Focus both on group and individual accountability
  - Members do real work together
  - Members taught social skills
  - Groups analyze how effectively they are at achieving their goals

Basic Elements of Cooperative Learning

High-Performance Coop Learning Groups

- Coop learning group that **exceeds all reasonable <u>expectations</u>**
  - Higher level of commitment
  - Rare
  - Most groups never achieve this level

Figure 5.1 Cooperative Efforts



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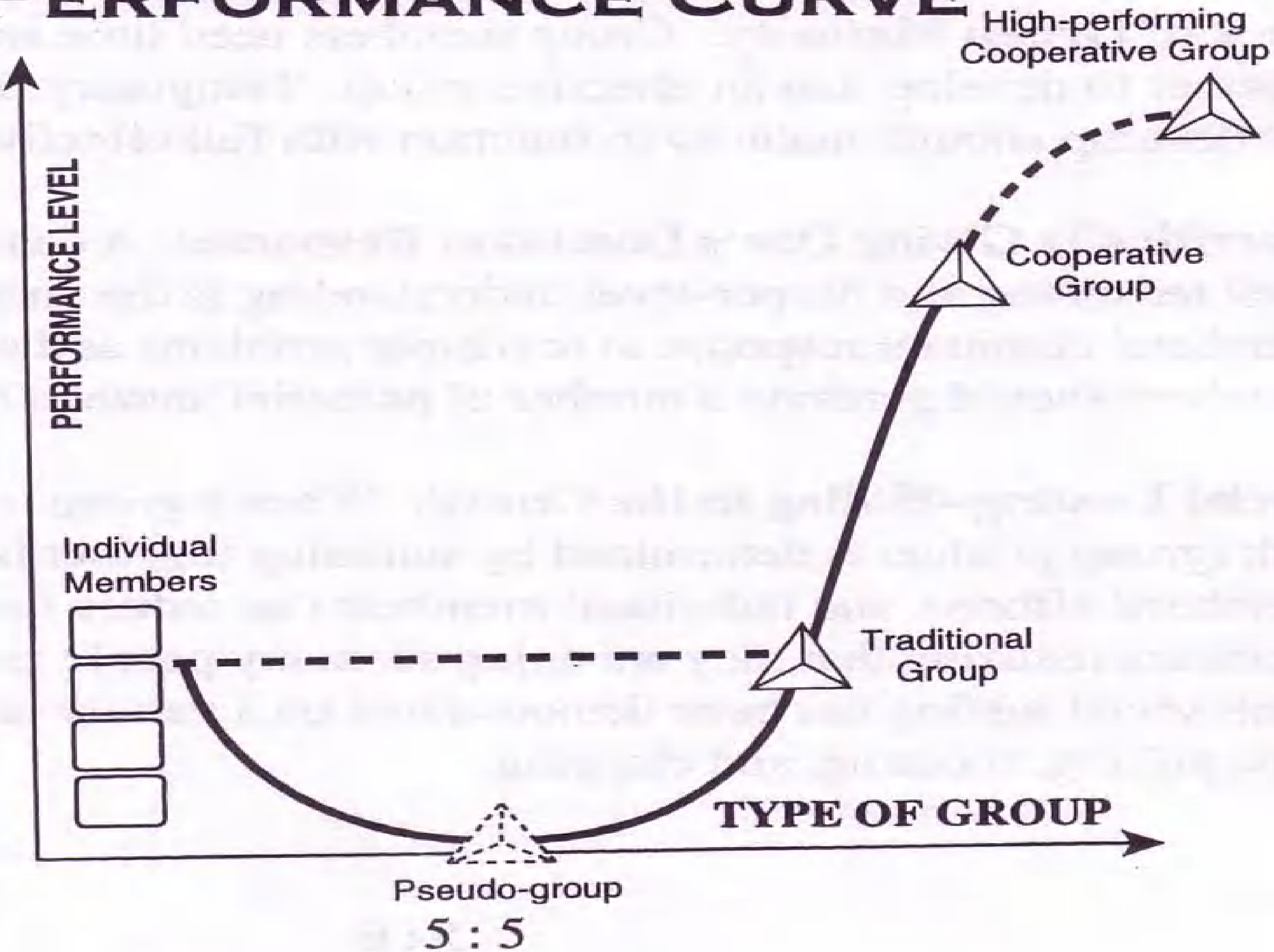
Johnson, Johnson, & Smith 1998

Figure 5.2 The Learning Group Performance Curve



Johnson, Johnson, & Smith (1998)

TABLE 1.1 COMPARISON OF LEARNING GROUPS

TRADITIONAL LEARNING GROUPS	COOPERATIVE LEARNING GROUPS
Low interdependence. Members take responsibility only for self. Focus is on individual performance only.	High positive interdependence. Members are responsible for own and each other's learning. Focus is on joint performance.
Individual accountability only.	Both group and individual accountability. Members hold self and others accountable for high quality work.
Assignments are discussed with little commitment to each other's learning.	Members promote each other's success. They do real work together and help and support each other's efforts to learn.
Teamwork skills are ignored. Leader is appointed to direct members' participation.	Teamwork skills are emphasized. Members are taught and expected to use social skills. All members share leadership responsibilities.
No group processing of the quality of its work. Individual accomplishments are rewarded.	Group processes quality of work and how effectively members are working together. Continuous improvement is emphasized.

Basic Elements of Cooperative Learning

Forces Hindering Group Performance

- Lack of group maturity
- Uncritically giving one's dominant response
- Social loafing – hiding in the crowd
- Free riding
- Motivation losses due to perceived inequity
- Group thinking
- Lack of sufficient heterogeneity
- Lack of teamwork skills
- Inappropriate group size

Positive Interdependence: We Instead of Me

- Three steps to structuring **positive interdependence:**
  - **Assigning the group a clear, measurable task**
    - Members need to know what to do
  - **Structure positive goal interdependence**
    - All members scoring above a specified criterion when tested individually
    - All members improve their performance over their previous scores
    - The overall group score being above a specified criterion
    - One product successfully completed by the group

Positive Interdependence: We Instead of Me

- **Supplement positive goal interdependence with <u>other</u> types of positive interdependence:**
  - Reward interdependence
  - Resource interdependence
  - Role interdependence
  - Identify interdependence
  - Environmental interdependence
  - Fantasy interdependence
  - Task interdependence
  - Outside enemy interdependence (see p.5:10)

Individual Accountability/Personal Responsibility

- **The discipline of using cooperative groups includes structuring group and individual accountability:**
  - **Group accountability:** The performance of the overall group is assessed and given back to all group members
  - **Individual accountability:** The performance of each individual member is assessed, the results are given back to the individual and the group to compare

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Individual Accountability/Personal Responsibility

- The **purpose** of cooperative groups is to make each member a **stronger individual**. (*note-reverse*)

  - With cooperative groups:
    - First, Students learn knowledge, skills, strategies, or procedures in a cooperative group
    - Then, Students apply the knowledge or perform the skill, strategy, or procedure alone to enhance mastery of material

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Individual Accountability/Personal Responsibility

- **Positive interdependence and accountability**
  - **Personal accountability**
    - Contributing his or her efforts to accomplish the groups goals
    - Helping other group members do likewise
    - Do what ought to be done
      - Sharing
      - Contribute
      - Pulling one’s weight
      - (*attaining competencies individually, but at higher level in group)*

Face-To-Face Promotive Interaction

- The discipline of using cooperative groups includes ensuring that group members **meet face-to-face** to work together to complete assignments and promote each other's success (*note-virtual*)
  - Schedule time for the group to meet
  - Highlight positive interdependence that **requires** groups to work together
  - Encourage promotive interaction among group members

Interpersonal and Small Group Skills

- Teaching group members the **small group** and **interpersonal skills** they need to work effectively with each other

  - **Students are <u>required</u> to learn:**

    - academic subject matter (**taskwork**)

    - the interpersonal and small group skills required to function as part of a group (**teamwork**)

No Teamwork Skills,……… No Taskwork

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Group Processing

Group processing

- **Reflecting** on a group session to:
  - Describe what members actions were helpful or unhelpful
  - Make decisions about what actions to continue or change
- Purpose is to **clarify and improve the effectiveness** of the members to achieve the group goals

Group Processing

- **Five steps in structuring group processing:**
  - **<u>Assess</u> the <u>quality</u>** of the interaction among group members as they work to maximize each other's learning.
  - Give each learning group **<u>feedback</u>** on how the group does its work
  - Groups **<u>set</u> <u>goals</u>** as to improve their effectiveness
  - Process how effectively the **whole <u>class</u>** is functional
  - Conduct small-group and whole-class **<u>celebrations</u>**

Positive Interdependence & Intellectual Conflict

- The **greater** **positive interdependence**,

  the **greater** the likelihood of ...

  intellectual disagreement and conflict among group members

****This is a good thing!**

Reducing Problem Behaviors

- When students first start working in cooperative learning groups, they sometimes engage in **unhelpful behaviors**.

- Whenever inappropriate student behavior occurs, your first move should be toward **strengthening the perceived interdependence**

Reducing Problem Behaviors

- **Student Not Participating or Bringing Work or Materials:**

Assign student role essential for group success

Reward group if all members achieve up to criterion to increase peer pressure to participate

Reducing Problem Behaviors

- **A Student is Talking About Everything But the Assignment:**

Give a **reward** the student or group finds especially attractive

Structure task so **steady contributions** are required for group success

Reducing Problem Behaviors

- **A Student is Working Alone and Ignoring the Group Discussion:**

Limit resources in the group (if there is only one pencil, the student will be unable to work alone)

Jigsaw materials so that the students cannot complete the assignment without other members' information

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Reducing Problem Behaviors

- **A Student is Refusing to Let Other Members participate:**

Jigsaw resources

Assign other members essential roles (leader, recorder, etc.)

Reward on group basis of the lowest two scores by group members

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Research

Different types of research:

1. **Experimental Research (controlled experimentation)**
2. Survey Research
3. Qualitative Field Research
4. Unobtrusive Research (content analysis, analyze existing statistics, historical comparative analysis)
5. Evaluation Research
6. – Others –

Two general components/phases of **experimental research**:

1. Setting up appropriate designs/models for collecting data.

2. Appropriate statistical analysis of the data to address the research questions.

Actually the second, development of statistical techniques, preceded the first, consideration of experimental designs.

Campbell and Stanley (1966) quoted from McCall (1923):

“There are excellent books and courses of instruction dealing with the statistical manipulation of experimental data, but there is little help to be found on the methods of securing adequate and proper data to which to apply statistical procedure.”

Campbell and Stanley’s separately published chapter, *Experimental and Quasi-Experimental Designs for Research*, remains one of the most complete and most read discussions on experimental designs for research in education.

The basic experimental inference:

We want to infer that the treatment or intervention, X, caused or was directly related to the observations made (the data that were collected):

X   O

We want X to be the <u>only</u> explanation for O. But there are often other plausible explanations, other variables, that can explain O.

These other variables are considered threats to the basic experimental inference – threats to the internal validity of our experiment.

Our research is weakened to the extent that the basic experimental inference is threatened by alternative explanations.

Campbell and Stanley consider several experimental designs and discuss the various threats to the validity of those designs.

Design 1. The One-Shot Case Study

X O

This design suffers from many weaknesses (threats to its validity). Some will be discussed as we look at a few other designs.

But the primary weakness of this design is the absence of any comparative data.

Campbell and Stanley:

"… such studies have such a total absence of control as to be of almost no scientific value. The design is introduced here as a minimum reference point."

"Basic to scientific evidence … is the process of comparison, of recording differences, or of contrast."

In this design the inference of treatment effectiveness is based on a comparison "…with other events casually observed and remembered, …general expectations of what the data would have been had the X not occurred, etc., …and in such instances involve the error of *misplaced precision*."

In other words, we just kind of 'feel' the treatment was effective because the data appear acceptable. This is not scientific.

Design 2. The One-Group Pretest-Posttest Design

O X O

A little better than design 1(there is a pretest for comparison to the posttest scores), but the design suffers from several weaknesses – threats to its validity.

History. Events that occur between the pretest and posttest, in addition to the treatment X, that could effect the posttest scores.

Maturation. Changes in subjects, in addition to the treatment X, that could cause changes in posttest scores. These are “a function of the passage of time per se (not specific to particular events), including growing older, growing hungrier, growing more tired, and the like.”

Testing. Actually taking the pretest may effect scores on the posttest beyond the effects of the treatment X.

Instrumentation. The pretest and posttest may be different instruments – they shouldn’t be. “…[C]hanges in the calibration of a measuring instrument or changes in the observers or scorers used may produce changes in the obtained measurements.”

Regression. Can occur when subjects have extreme (either high or low) pretest scores. By the phenomenon of statistical regression (or regression toward the mean) at the posttest, extreme scorers tend to score ‘away’ from their extreme and toward the mean. Posttest scores may have nothing to do with the treatment X.

Design 3. Static-Group Comparison

X	O
	O

Two groups; one group received the treatment, the other group did not. The scores from the two groups can be compared.

The problem is that these are usually existing (static) groups; a group that happened to receive the treatment is compared to a group that did not. But subjects were not explicitly (and randomly) assigned to groups.

This design is not weakened by the five previous threats, *history*, *maturation*, *testing*, *instrumentation*, and *regression*, because these variables threaten the change observed between the pretest and posttest; this model has only one testing time.

But this model can be weakened by other threats, such as:

Selection. One group of subjects may be qualitatively different from the other group, at least in regards to the dependent variable (whatever the test is measuring).

Mortality. Differential loss of subjects related to group membership or group dynamics or other group-specific factors.

Design 6. Posttest-Only Control Group Design

R	X	O
R		O

The difference between this design and design 3, the static-group comparison, is in the random assignment (R) of subjects to experimental and control groups.

This is a very acceptable design. Like design 3, it is not weakened by *history*, *maturation*, *testing*, *instrumentation*, and *regression* because this is not a pretest-posttest design.

In addition, *Selection* is not a threat because random assignment to groups assures there is no bias in group membership. Differential experimental *Mortality* is also not a threat because, again due to random assignment, any factors resulting in the loss of subjects should affect both groups equally.

Design 4. Pretest-Posttest Control Group Design

R	O	X	O
R	O		O

This design differs from design 6 by the inclusion of pretesting.

It has the advantage of design 6 in not being susceptible to *selection* and *mortality* (because of randomization).

The design appears to be susceptible to *history*, *maturation*, *testing*, *instrumentation*, and *regression*. These variables can, in fact, effect the pretest-posttest comparisons in the two groups.

But, because there are two groups AND subjects were randomly assigned to each group, we can assume that the effects of these variables are equalized across both groups.

So, *history*, *maturation*, *testing*, *instrumentation*, and *regression* are not avoided or eliminated – they are controlled.

This is probably the most used experimental design. Sometimes called the classical experimental design.

Of the sixteen designs discussed by Campbell and Stanley, designs 4, 5, and 6, are "the most strongly recommended designs of this presentation."

Design 5. Solomon Four-Group Design

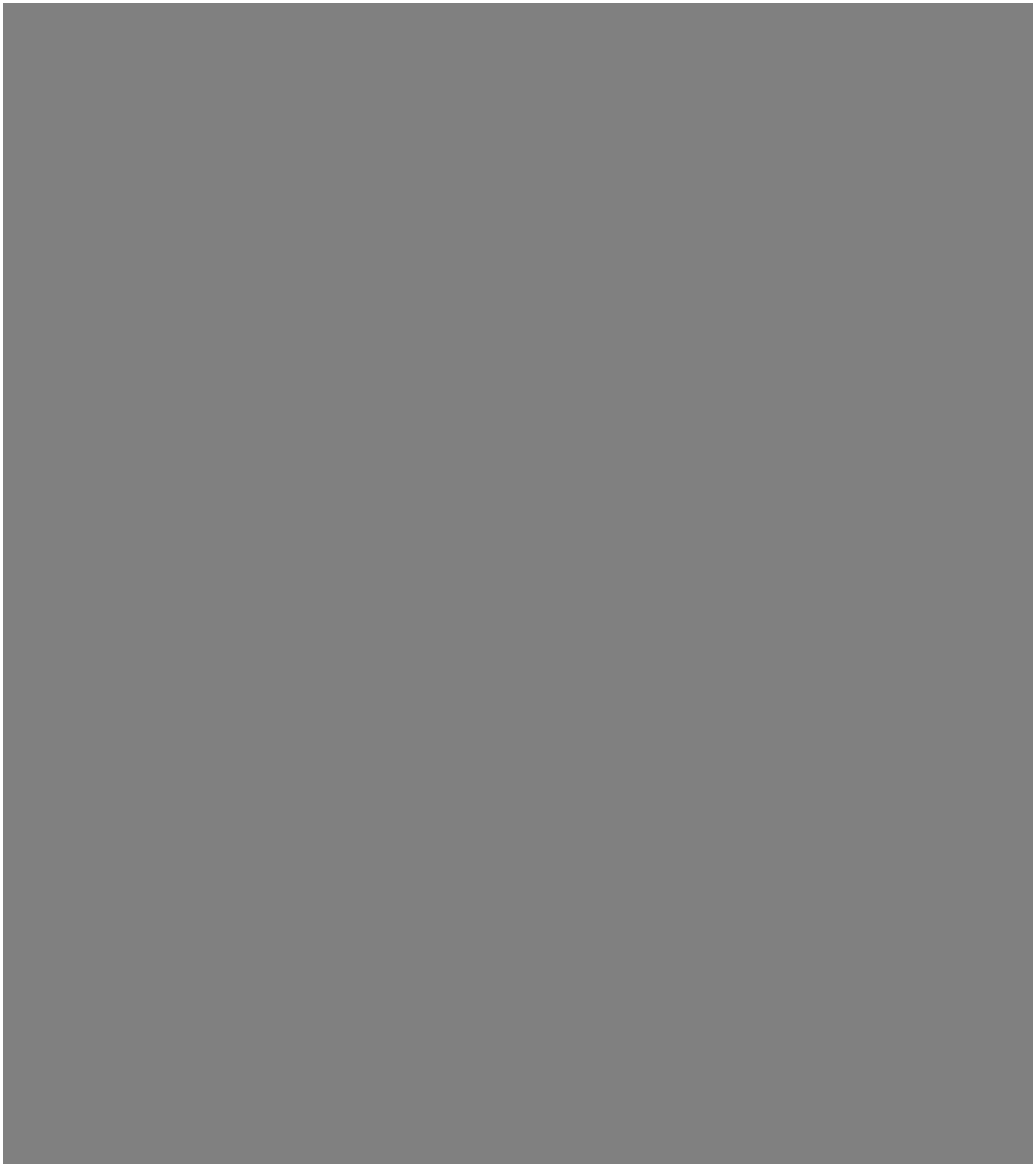
R	O	X	O
R	O		O
R		X	O
R			O

The basic appearance of this design is the combining of the two groups from design 4 with the two groups from design 6.

Designs 4, 5, and 6, all control the major threats to internal validity. Designs 5 and 6 have the added advantage of controlling one of the threats to external validity.

Internal validity relates to the extent to which change can be attributed to the treatment and not to other variables (like *history*, *maturation*, etc.)

External validity relates to the appropriateness of generalizing experimental results to other populations, settings, treatment variables, and measurement variables.



The Basic Logic of Inferential Statistical Methods

Often, in the experimental designs on the previous pages, we wish to compare the means of scores from two groups: experimental vs. control, or pretest vs. posttest.

Consider $\bar{X}_1$ and $\bar{X}_2$.

[In statistics the symbol μ is used to represent the true mean of a group and $\bar{X}$ is the computed mean of the actual data from the group.]

The logic of statistical inference requires us to specify a *null hypothesis* which states that the two true means are equal (even though we generally hope or expect that they are unequal):

$$H_o: \mu_1 = \mu_2$$

The statistical test will then compare (test) this null hypothesis against a more general alternative hypothesis:

$$H_a: \mu_1 \neq \mu_2 \qquad [\text{or } \mu_1 < \mu_2 \text{ or } \mu_1 > \mu_2]$$

Of course, the actual computed means will likely be unequal. Let's assume that the mean for the experimental group is 10 points greater than the mean for the control group ($\bar{X}_2 - \bar{X}_1 = 10$). But is this 10-point difference big enough for us to infer that the experimental treatment is really effective?

That is the basic question: how big of a difference is big enough?

Inferential statistical procedures will help answer that question.

The process involves probabilities, normal curves, and input from the researcher and, as a result of the statistical test, we could determine that a mean difference of 7.34 points (or whatever) is sufficient for us to judge that the treatment is indeed effective in changing scores.

Based on the statistical test we will either retain the null hypothesis or reject it – that's all the statistical procedure allows us to do.

If we reject it, we are supporting the alternative hypothesis – for this example we are inferring that the treatment is effective.

If we retain the null, we are not supporting the alternative – we are inferring that the treatment is not effective.

In either case, there is a small probability that we are wrong. This means that <u>inferential statistical procedures do not allow us to conclusively prove</u> that the treatment is effective or is not effective.

Study 1 –Traditional Assessment With Performance Assessment

This study is designed to examine two questions:

1. Does a performance test administered in conjunction with a traditional cognitive test result in increased learning beyond the traditional test alone as indicated by the traditional cognitive test?

2. Does a performance test administered in conjunction with a traditional cognitive test result in increased knowledge retention beyond the traditional test alone as indicated by a final exam?

The basic design for this study is presented in the table below.

Study 1: Traditional Assessment With Performance Assessment					
		Treatment	Posttest 1		Posttest 2
Experimental Group	Instruction	Performance Test Related to Traditional Test	Traditional Test	----------→	Traditional Final
Control Group	Instruction	Performance Test Not Related to Traditional Test (Placebo)	Traditional Test	----------→	Traditional Final

Study 2 – Performance Assessment and Traditional Assessment Administered in Different Order

This study is designed to examine the following questions:

1. Does a performance test administered in conjunction with a traditional cognitive test result in increased learning beyond the traditional test alone as indicated by the traditional cognitive test?

2. Does the order of administration of a performance test and a traditional test affect knowledge retention as indicated by a final exam?

The basic design for this study is presented in the table below.

Study 2: Performance Assessment and Traditional Assessment Administered in Different Order					
Group 1	Instruction	Performance Test	Traditional Test	----------→	Final
Group 2	Instruction	Traditional Test	Performance Test	----------→	Final

Study 3 – Passive Learning vs. Active Learning

This study is designed to examine the following questions:

1. Does passive learning vs. active learning result in differential knowledge gains as indicated by a traditional cognitive test?

2. Does passive learning vs. active learning result in differential knowledge retention as indicated by a final exam?

The design for this study is presented in the table below.

Study 3: Passive Learning vs. Active Learning

	Treatment	Posttest 1		Posttest 2
Passive Learning Group	Passive Learning	Traditional Test	----------→	Final
Active Learning Group	Active Learning	Traditional Test	----------→	Final

Treatment				
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Passive	Active	Passive	Active
2	Active	Passive	Active	Passive

Study 4 – Individual Learning vs. Cooperative Learning

This study is designed to examine the following questions:

1. Does individual learning vs. cooperative learning result in differential knowledge gains as indicated by a traditional cognitive test?

2. Does individual learning vs. cooperative learning result in differential knowledge retention as indicated by a final exam?

The design for this study is presented in the table below.

Study 4: Individual Learning vs. Cooperative Learning

	Treatment	Posttest 1		Posttest 2
Individual Learning Group	Individual Learning	Traditional Test	----------→	Final
Cooperative Learning Group	Cooperative Learning	Traditional Test	----------→	Final

	Treatment			
Group	Content Area I	Content Area II	Content Area III	Content Area IV
1	Individual	Cooperative	Individual	Cooperative
2	Cooperative	Individual	Cooperative	Individual